NRL Memorandum Report 2204

Pilot Model for a Management Information System on Work Unit Information

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CONTENTS

ABSTRACT

The continuing need for efficiency in the management of Research, Development, Test and Evaluation (RDT&E) programs conducted at naval laboratories has motivated an inquiry into the means by which program management information is collected, processed, and disseminated. The use of this information in the fulfillment of reporting requirements imposed on naval laboratories has been considered, as has the internal management function.

Present procedures impose an unnecessary burden on laboratory investigators who are required to supply numerous overlapping reports; these procedures do not serve laboratory managers well because the reports are individually incomplete and may be collectively inconsistent. The problem seems to arise from the tendency to pass down to the investigator the task of producing the required report in complete, publishable form. The solution to the problem involves separating the collection of information from the generation of reports, employing ADP techniques to bridge the gap.

The design goals of such a system, as well as a description of the necessary steps towards its implementation, are presented. Appendixes surveying technical alternatives for data capture, computer assisted publication, and conversational information systems, are included.

PROBLEM STATUS

This is an initial report on this project; work is continuing.

AUTHORIZATION

NRL Problem B02-07
DNL Project ZF-099-01-01

FOREWORD

It should be noted that this memorandum report is being distributed to engender comment and discussions, and that its distribution does not necessarily imply complete endorsement by NRL management.

The author would like to express gratitude to Dr. Bruce Wald for his service and suggestions throughout the formation of this report and more specifically for the authorship of Appendix F -- Specification for Multifunction CRT Terminals.

PILOT MODEL
FOR A MANAGEMENT INFORMATION SYSTEM
ON WORK UNIT INFORMATION

1.0 INTRODUCTION

Although naval laboratories invest a large effort in the collection and dissemination of management information in response to externally imposed and internally generated requirements, no integrated system exists to minimize the collection burden, to present a uniform and accurate picture to laboratory management, and to be responsive to management queries.

In Section 2.0 of this report, current Naval Research Laboratory (NRL) procedures will be described. These procedures appear to differ little from those of other naval laboratories. In Section 3.0, an attempt is made to explain why, despite the burdensome requirements placed on laboratory investigators in the composition of reports, these reports do not fulfill management needs. Section 4.0 describes a pilot model of a system that will both reduce the burden on the investigators and increase the utility of the reports produced by the system. Section 5.0 outlines some of the implementation procedures that will lead to such a system.

2.0 CURRENT PROCEDURES

2.1 Managerial Terminology

The primary unit of internal budget control is the NRL Problem Number*, which may contain more than one Job Order Number if several Divisions participate in the prosecution of one problem. Some NRL problems correspond to a single work unit; other NRL problems correspond to several work units. In those cases where several work units are subsumed in a single NRL problem, Point Numbers are added to the problem number in order to have identification symbols in NRL problem number format but in one-to-one correspondence to work units.

2.2 Major Managerial Documents

Most of the labor in composing various management documents is supplied by the principal investigator*, who is usually below the fourth echelon in the NRL Research Department. A principal investigator is responsible for one or more work units.

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* See Appendix A for NRL organizational and work-unit accountability structures and the relationships among the terms used in these paragraphs.

TABLE 1
Major Management Documents (NRL)

Document	Time of Composition	Scope	Purpose	Remarks	Designation
DD 1498	Irregular, twice yearly	Work Unit	Meet DDR&E requirement		
LPS	March, December	Work Unit	SEE TEXT		
Problem Acceptance Form	As required	a) New problem b) New work unit c) New effort under an existing work unit	Initial or updated budget information Program description Notification of additional resources needed		
A-1 (NRL) Budget Form	April, October	NRL Problem	Budget allocation Commitment of staff to problem	For approved problems	Budget Office
A-4	As required	NRL Problem		An 'A-1' for proposed problems and for requested additional project funding	Various
Staffing Plan	April	Branch	Predictions of required staff, acquisitions, separations, etc.	Interpreted into Division Staffing Plan	Division

The principal investigator is required to compose or contribute to the documents enumerated in Table 1. Samples of the DD 1498, LPS, Problem Acceptance Form, A-1, A-4, and Staffing Plan are included in Appendix B for reference.

2.2.1 DD 1498--The DD 1498 is generated in response to a Director of Defense Research and Engineering (DDR&E) requirement [1]. The Defense Documentation Center (DDC) requires that changes to the latest DD 1498 in the work-unit data bank be submitted to them in machine-readable form. The present Navy method of meeting this requirement is for the naval laboratories to submit revised (or new) DD 1498's in clean hard-copy form to NARDIS. NARDIS keypunches them, processes them, and interacts with DDC. Figure 1 shows the procedures required at NRL in the preparation of the DD 1498.

2.2.2 LPS--The Laboratory Program Summary (LPS) is designed to serve a number of purposes. Unlike the DD 1498, which reports status information, the LPS contains planning information, including detailed descriptions of requirements, technical approach, and future milestones. The LPS contains privileged information, and its circulation is controlled. The LPS should serve all the system command (SYSCOM) requirements for periodic, technically oriented management reporting; it is hoped that those other commands which are now requesting similar reports in different formats and at other intervals will accept the LPS.

The LPS could serve as a principal vehicle for the maintenance of technical overview by the top management of the naval laboratories and by DNL/DLP, provided that it is carefully prepared and that suitable methods of access are developed. The LPS is sometimes used as a negotiation document with sponsors, and further extension of this use would be desirable.

Figure 2 shows the procedures currently followed at NRL in the preparation of the LPS. Each function may have to be repeated, with most of these repetitions involving the principal investigator.

2.2.3 Problem Acceptance Form--The Problem Acceptance Form (PAF) is an internal document used for internal approvals of problem proposals and acceptances. It is routed through the management chain of the cognizant research area and among those support activities which would be utilized in fulfillment of the problem goals. Figure 3A shows routing required for PAF proposals, and Figure 3B shows the routing chain for a problem acceptance PAF.

2.2.4 Budget Forms--The A-1 is NRL's internal budget form for active problems (routing is shown in Fig. 4), and the A-4 is the internal budget form for anticipated proposals and augmentation of current problems.

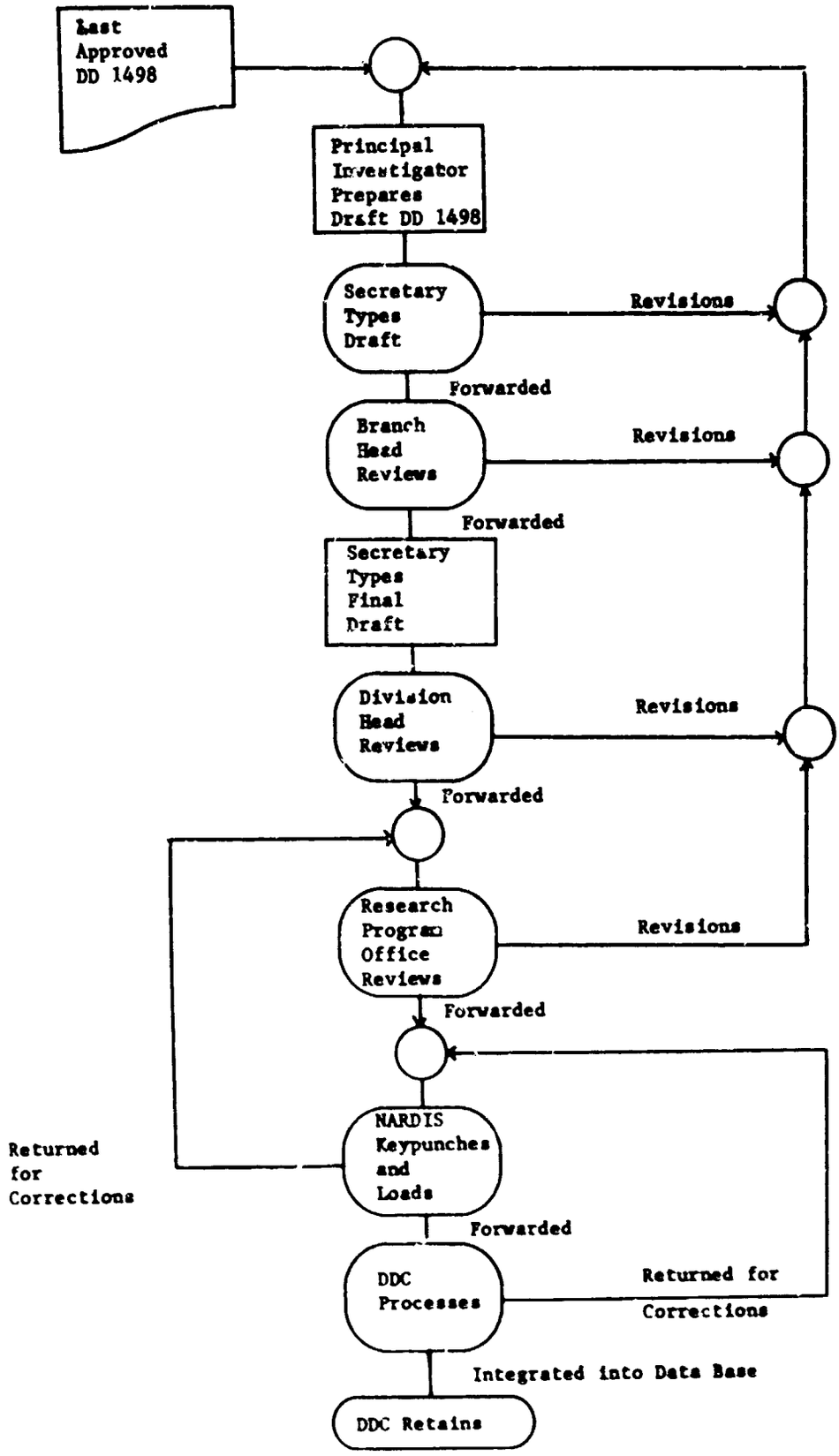

Fig. 1 - Current DD 1498 Preparation Procedures

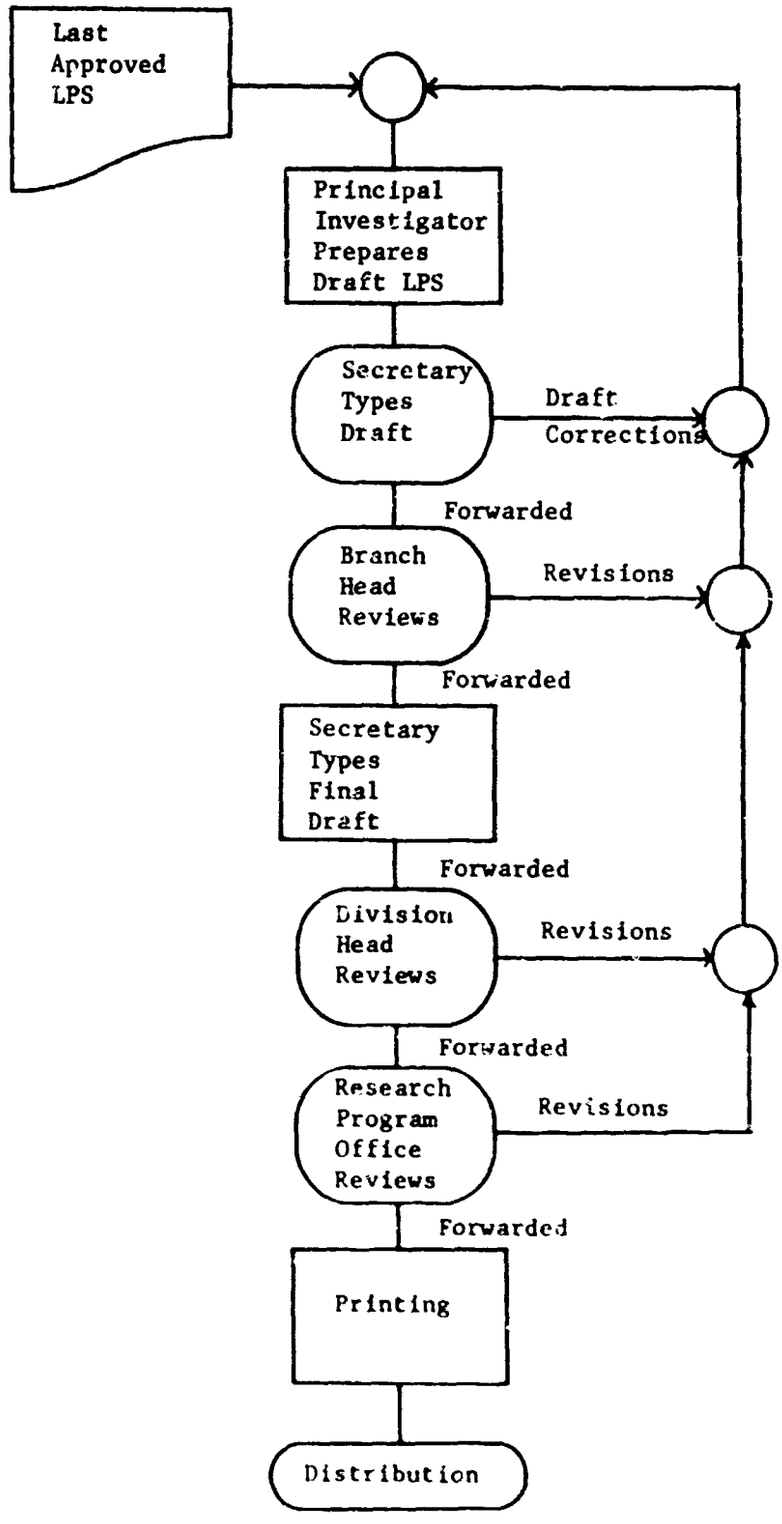

Fig. - Current LPS Preparation Procedures

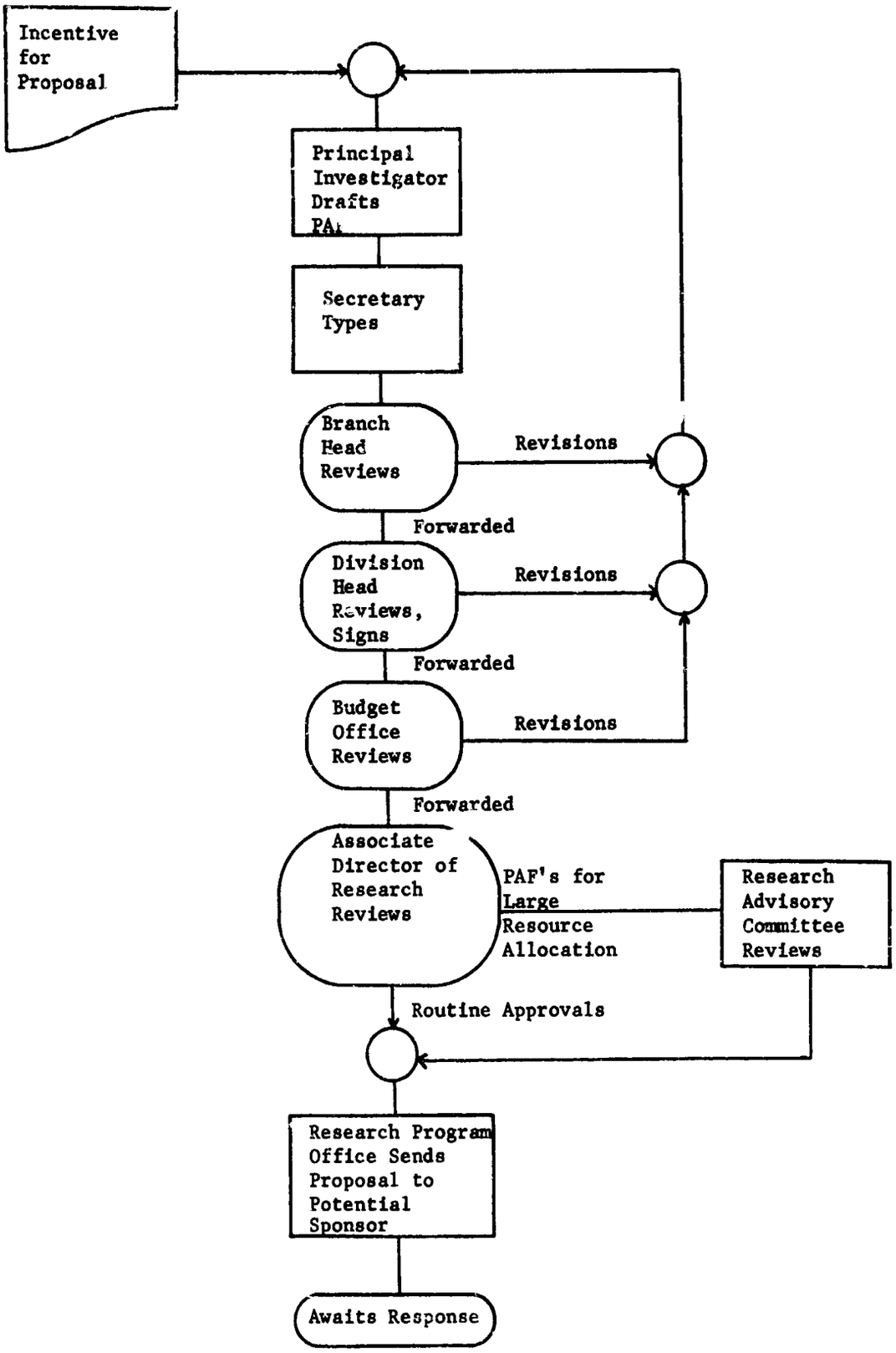

Fig. 3A - Current Procedures for PAF Proposals

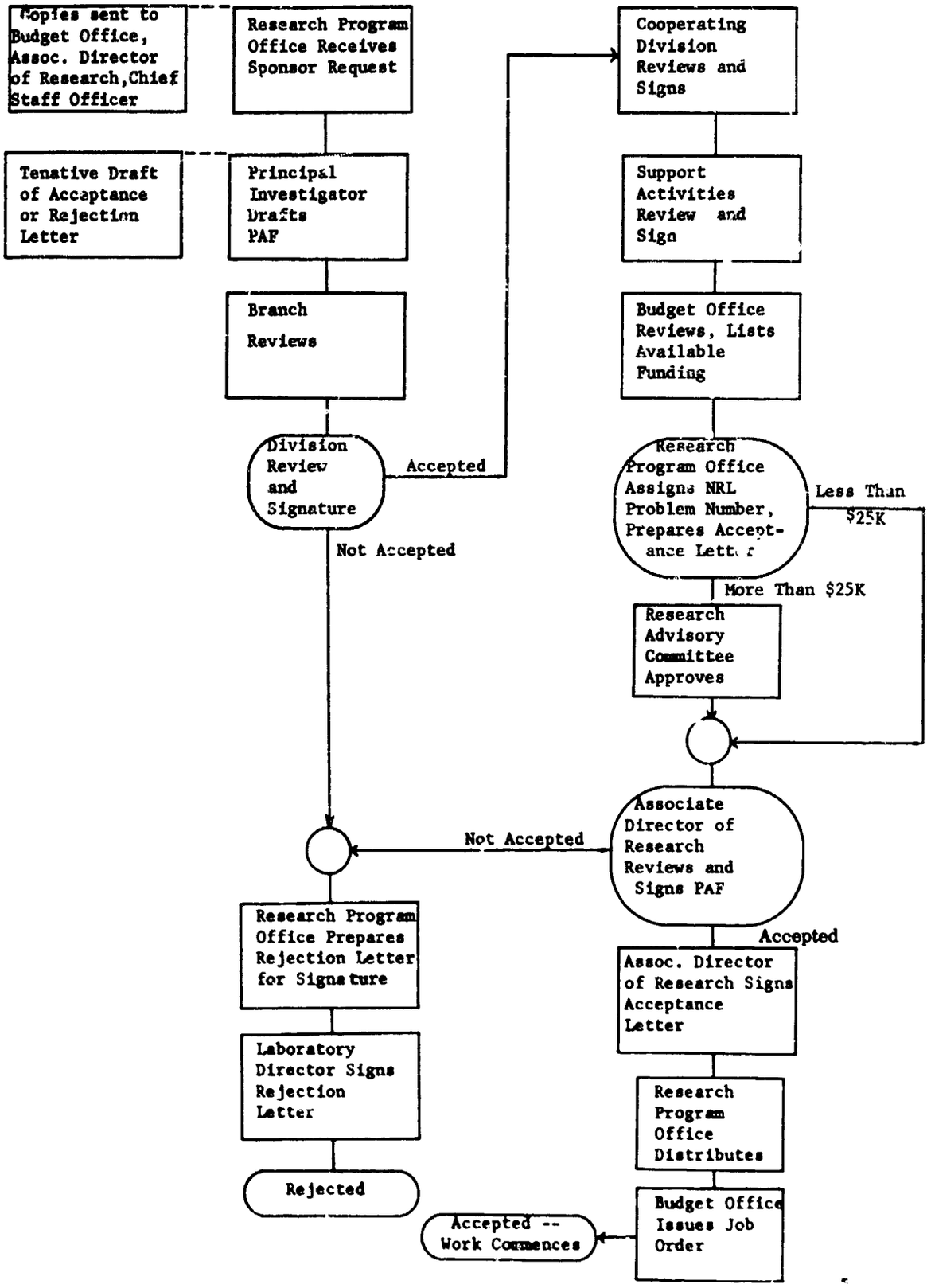

Fig. 3B - Current Procedures for PAF Acceptance

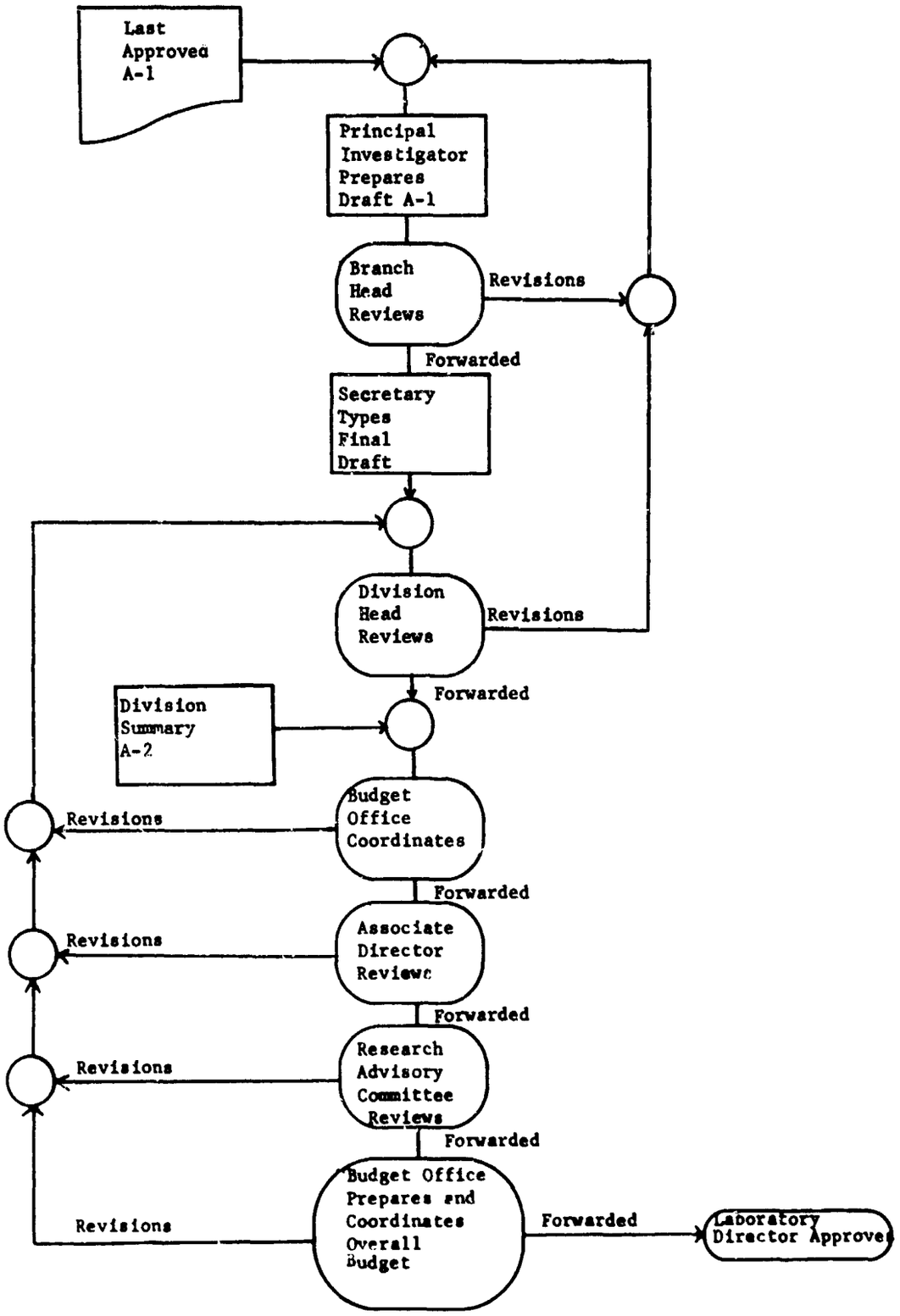

Fig. 4 - Current Budget Preparation Procedures

2.2.5 Staffing Plan--Although the A-1 budget form designates personnel who can be charged to a particular problem, the A-1 information is not processed by the Personnel Division and is lacking in projected information such as anticipated separations, proposed grade raises, proposed acquisitions, etc. The Staffing Plan includes this information. It is submitted to the Personnel Division annually by each Division in the laboratory.

3.0 DEFECTS IN CURRENT FORMS AND PROCEDURES

Discussions here will be limited primarily to the LPS and DD 1498 but most of the problems are also evident in the other forms discussed in Section 2.0. The principal defects in current methods include:

- The principal investigator spends too much time in the many preparation cycles, as do Research Department typists.
- The quality of the products is uneven.
- Top management often does not find the answers to its questions in these documents.

The causes of these defects will now be considered.

3.1 Time Wasted

There are two major sources of the frustration felt by the principal investigators and those who type and proofread the documents.

1. The principal investigator is required to compose a number of different documents from a single data base, his mind. He senses that while forms may be designed to serve specific end uses, they are not designed to simplify his supplying of the information. He resents having to tell different aspects of the same story again and again in differing formats.

2. The requirement to produce clean, complete, photoreproducible documents leads to a secretarial burden. Although typing is a normal secretarial duty, typing a heavily formatted form is not simple, and the forms are often retyped several times in the course of the review cycle. Most managers prefer to use their secretaries for nonroutine technical correspondence to meet dynamic daily requirements. Top management would even like to see a reduction in the number of secretarial billets, so that more technical people can be acquired within the laboratory ceiling.

Many of the data elements that have to be filled in change infrequently but must be retyped at every submission. It is ironic that in updating a DD 1498, the principal investigator often pencils his changes on the previous submission, but after laborious typing, review

keypunching, etc., a complete hard copy DD 1498 is forwarded to NARDIS from the laboratories even though only the changes need to be submitted to DDC.

3.2 Uneven Quality

The question of quality may be subdivided into two elements: the heavily formatted information (e.g., task area numbers) and the textual information (e.g., progress since last report).

Although the heavily formatted information changes infrequently, errors are caused in the retyping process and sometimes through the selection of the wrong form from the previous submission from which to copy the information. When this information actually does change, there is no convenient mechanisms for reminding the principal investigator of the change when the next submission is being prepared. This deficiency could be corrected within the present system by having the Research Program Office preprint forms, on an individual basis for each work unit, with the heavily formatted data completed.

The uneven quality of the textual information reflects a lack of enthusiasm on the part of the principal investigator toward his composition chore. Although NRL and other laboratories give detailed instructions specifying the type of data required in the various textual data blocks, little if any review is made of these data blocks before the documents leave the laboratories. In general, many authors believe that no one, except for bureaucratic functionaries, reads his text. There is an element of circularity to this argument--the products may be poor because the author senses that important decision makers do not read them; the decision makes may not read them because the products are poor and because of the plethora of reports on the same tasks, none of which provide complete, self-sufficient bodies of information.

This is a poor argument with respect to DD 1498's; Congressional Staffs do read them, but many authors are unaware of the damage that can be done by a poorly worded DD 1498. The document must be made more positive.

Some LPS's reach the desk of the cognizant engineer in sponsoring system commands. Often, the program books merely occupy space in the systems command (SYSCOM) libraries, and the cognizant engineer must receive his information directly from the principal investigator.

3.3 Inconsistency

Because the various reports are independently submitted and reviewed, there is no mechanism for assuring consistency between reports. The calls for A-1's, DD 1498's, LPS's, and Staffing Plans are issued at different times; perhaps this is because they are recognized as burdensome. There is no one central agent in NRL that processes all of the

documents to assure, for example, that the sum of the financial information on a set of work unit LPS's will equal that on the A-1 for the problem including the work units. Personnel are identified on A-1's and staffing plans, but because the A-1 is a Budget Office document, it is not normally routed through the Personnel Office.

Inconsistencies can also result from misunderstandings about different methods of treatment of similar information required on different forms. Few authors seem to know how to treat fiscal carry-over. This is an example of a fairly complex matter for which it is not reasonable to expect expertise on the part of every author.

3.4 Lack of Utility to Top Management

High-level managers, e.g., Laboratory Technical Directors, Commanding Officers, etc., have a responsibility to keep continuously aware of the activities taking place in their organizations and must also respond rapidly to questions from their superiors. The documents that have been discussed should serve this purpose, but the inquiries often made by top managers would seem to suggest that despite the heavy investment made in the production of these documents, they are not serving the managers well.

There are at least three reasons for this failing:

1. Each document tells only part of the story
2. The quality is uneven
3. Sophisticated access methods do not exist.

The first two points have been discussed already; the third may require some explanations.

NRL has active at anyone time approximately 600 LPS's, about an equal number of DD 1498's, 400 NRL Problems with associated A-1's and accounting reports, numerous PAF's, staffing plans, etc. It would be unreasonable to expect a Director of Research to rummage through this mass of paper. Furthermore, his information requirements would usually not be satisfied by data elements from single reports; more often he requires synopsized summary and trend information across the total of the information available.

Examples of typical questions that require answers are:

- Should the support activities be expanded or curtailed for the next fiscal year?
- What skills will be required within Division X to meet sponsor needs for the next fiscal year?

- How does the manning of Project Y (grade level, college degree, skills) compare with the resources applied to other projects in Division X?

At present these questions can be answered by diverting personnel to sift through numerous pieces of paper.

4.0 DESIGN GOALS OF AN INTEGRATED SYSTEM

The defects in current procedures just recounted suggest a number of goals for a new system. These goals are described briefly here. Section 5.0 will detail the approaches that are being taken in the building of the pilot model. The goals are:

- Reduction of the burden on the principal investigator by --

    1. Use of a single format for collection of management information.

    2. Acceptance of changes only rather than entire documents.

    3. Acceptance of legibly handprinted material.

- Maintenance of an up-to-date data base of the information provided by the principal investigator.

- Use of this data base to generate required routine reports and to disseminate these reports automatically.

- Facilitation of on-line inquiry of the data base in a manner useful to management.

4.1 Single Format

A key point is that the principal investigator prepares a single package which contains all the information required by various levels of management. The form on which this information is submitted should be designed for the convenience of the investigator without obeisance to the format of required reports; ADP can do the translation.

Another goal is to accept changes at any time without requiring a complete resubmission of a package. The principal investigator would always have available a readout of his package in the format in which he submitted it. When significant changes occur, he would be required only to submit the changes. In accordance with preestablished criteria, the system might or might not generate a revised output report.

A third goal is to accept legible handprinted material from the principal investigator. The data must be captured in machine-readable

form. Keypunching is an obvious technique, but other apparatus may be more efficient (see Appendix C - Data Collection Techniques). Since the reports are generated by the system, there is no need to perform both a typing and the equivalent of a keypunching job. Another alternative would be to employ typewriters with magnetic recording devices and editing capabilities.

4.2 Data Base Maintenance

The system data base would include at least all the information in the package. It would be necessary to maintain several values for many of the data elements. These values would include the latest received updated value awaiting approval, the last approved value, and for those data elements which are reported only on a change basis (e.g., DD 1498), the last reported value.

The integration of other data bases, such as accounting and personnel transactions, would be highly desirable, although this would be an ambitious undertaking. Even if full integration was deferred, it would be highly desirable to log the arrival of project orders so that at least the 'funds available' data element would reflect reality in terms of dollars available, and suitable tags could be maintained on expiration dates.

4.3 Report Generation

Software would be provided initially to produce from the data base the reports that are now composed by the principal investigator, i.e., LPS, DD 1498, PAF, and A-1. It would be relatively simple to add software to produce staffing plans and other documents which are derivable from the program package.

It should be noted that a variety of output media would be used for the reports; e.g., DD 1498 updates would be written on magnetic tape for submission either to NARDIS or directly to DDC. Some reports would be written by a line printer associated with the computer facility. Other reports, requiring publication quality, would be written by computer output microfilm (COM) equipment. These issues are considered in more detail in Appendix D, Output Media Survey.

The report-generation system can be of major assistance in assuring proper dissemination of reports. In addition to sending LPS books to systems commands, custom reports, with address labels, can be produced for individual technical agents (the sponsor's technical manager) in SYSCOMS or other sponsoring organizations.

4.4 Query Capability

The system should be capable of responding, preferably in real time, to queries. Responses may be of two general forms; a reference to an existing report or document, or information derived ad hoc from examining the entire data base.

It would probably be desirable to make use of existing time-shared data-management systems (DMS) to provide at least the second form of response. If such a DMS were used, one of the outputs of the data-base maintenance process would be a copy of the data base suitably formatted for entry into a time-shared DMS.

Alternate means of providing query capability are examined in Appendix E, Alternates for Providing Querying Capabilities.

5.0 STEPS TOWARD IMPLEMENTATION -- THE PILOT MODEL

Implementation of the integrated system involves the following activities:

- Choosing the data elements that will be maintained in the data base and collected by the Work Unit Package
- Establishing procedures for the capture of the data
- Developing software for the maintenance of the data base
- Developing procedures and software for report generation
- Interfacing with query processing systems.

5.1 Data Elements

Table 2 lists a recommended set of data elements for maintenance of the data base. It does not describe either the internal ADP storage elements or the form presented to the package author; these will be determined as the system evolves. Most of these data elements will be provided by the package author. Distinct data elements are maintained for names and codes of the package author and the principal investigator for two reasons.

- Administrators frequently perform reporting tasks to ease the burden on technical personnel.
- Since the Work Unit Package is designed for proposals as well as for reports on on-going projects, the principal investigator is not necessarily designated at the time of the first report.

NRL policy dictates that the principal investigator should author

package material in all possible cases to achieve the best technical material available. With the advent of the pilot model, the burden on the author should be minimal. As Table 2 indicates, other data elements may be obtained from the sponsor, the Research Program Office, and the Comptroller.

Enough information is maintained within the data base to provide basic indices for obtaining personnel information from a personnel data base (or personnel file if no automated data base exists), and for obtaining information from files maintained by the Supply and Budget Divisions. These files may be merged into the integrated data base in the future.

Table 2 also designates the data elements which are currently required for the major reporting documents. Other potential uses of data elements are noted under 'other'. These include elements needed as parameters for automatic report distribution (e.g., printing mailing addresses, etc.), as items necessary for management referencing and review, and as controls over what reports are allowed to be generated from the set of data elements defining a specific task.

Table 2 is not meant as a dictatorial, complete, or nonchanging set of elements, but it is presented as a minimum set of information which will be considered in the pilot model.

5.2 Data Capture Procedures

Figure 5 shows routing and procedures to be followed in the approval chain of a Work Unit Package submission to the pilot model. Path A proposes approvals on the handprinted data as originated by the principal investigator or package author, and Path B proposes approvals on 'proof' reports as generated by the Automatic Data Processing (ADP) system. The major deficiency of the Path A procedures is that the information which is approved may undergo erroneous alterations during the data-capture process, and since few people review the author copy after capture, an error may embarrassingly appear on a report generated from that information (Path B assures valid ADP capture). An obvious advantage is that if alterations of the data are required in the approval chain, they may be made directly, and the data will have to be captured a single time. Both Path A and Path B will be tried during the pilot model development.

The major activities involved in the preparation sequence are:

- Preparation by the package author
- Branch Head review
- Division Superintendent review
- Data capture

TABLE 2

WORK UNIT PACKAGE DATA ELEMENTS

Data Element Title	Major Management Document		
	DD 1498	LPS	A-1
Laboratory ID Assignment letter 2 digit group 2 digit group point (3 digit sub-unit) update sequence	10 A 4	9	(c)
* Work Unit Title	11	2	
* Problem Title			A
Prior Laboratory ID		4	
* Prior Title		4	
Package Author Last Name First Name Title Code Telephone			
Principal Investigator Last Name First Name Code Title Telephone	19 C (if monitor of contract)		
Proposal Yes or No Division Control No.	Controls Generation	7	Default to A-4 if true
Termination / Suspension	Controls Generation	Controls Generation	Controls Generation
Performance Method	16	10	
Abstract of Work			
Kind of Research			

NOTE: Number/letter combinations indicate data blocks on the specified form (see Appendix A). Parenthesized symbols indicate derived data blocks.

* Precede each data element with its security classification.

Table 2
(Continued)

Major Management Document			Source
PAF	Staff	Other	
3		Management Index	Research Program Office initially assigns, controls changes
9			Assigned by sponsor
6			Research Program Office controls for relevance
		Link to historical ref.	Research Program Office
		Link to historical ref.	Research Program Office
		Addressee of proof-copy	Package Author
		Management review	Package Author/ Research Program Office (Director of Research)
Controls generation		Controls generation of proposal for new sponsor	Package Author
Controls generation			Package Author
		Management review	Package Author
C		Management review	Package Author
		Management review	Package Author

Table 2
(Continued)
Work Unit Package Data Elements

Data Element Title	Major Management Document		
	DD 1498	LPS	A-1
Patents Pending/Granted			
Type			
Year Granted			
Scientific/Technological Areas	12		
Local Classification Scheme			
Work Security/Downgrading	6		
Report Security/Downgrading	5/7	heading	
1498 Accession Number	1		
Start Date of Work	13		
Estimated Completion Date	14	8B	
Primary Sponsor			
Assignment Number		1	D
Element/Appropriation	10 A 1	3A	D
Project Number	10 A 2		D
Task Area Number	10 A 3		D
Command Name	19, 15 A	3B	F
Command Address	19		
Program Manager	19	5	
Last Name			
First Name			
Title			
Code			
Telephone Number			
Technical Agent		6	
Last Name			F
First Name			F
Title			
Code			F
Telephone Number			

NOTE: Number/letter combinations indicate data blocks on the specified form (see Appendix A). Parenthesized symbols indicate derived data blocks.

Table 2
(Continued)

Major Management Document			Source
PAF	Staff	Other	
		Management review	Package Author
A		Management review	Package Author
		Management review	Each Laboratory will probably develop a scheme of most benefit for their managers.
		Management review	Package Author, Security Office, highest of data element classifications.
heading		Controls distribution	Package Author, Security Office, highest of data element classifications.
			DDC after the first submission of a new work unit.
(11)		Management review	Package Author, Research Program Office
(11)		Management review	Package Author
8		Man. review	Package Author, Research Program Office
7		Distribution Distribution	Internal Computer File.
		Distribution	Package Author, Research Program Office
		Distribution	Package Author, Research Program Office

Table 2
(Continued)
Work Unit Package Data Elements

Data Element Title	Major Management Document		
	DD 1498	LPS	A-1
First/Second Contributors			
Element/Appropriation	10B1, 10C1		
Project Number	10B2, 10C2		
Task Number	10B3, 10C3		
Command Name	15B, 15C		
Command Address			
Contractor (RDT&E)		12	
Name	20A		
Address	20B		
Lead Contact			
Last Name	20C		
First Name	20C		
Title			
Code			
Social Security No.			
Telephone	20D		
Start Date	17A1	12G	
Stop Date	17A2	12G	
Type Contract/Grant	17C		
Partial Contract (?)	17D1		
Kind of Award	17E		
Number	17B		
Amount	17D2	12G	
Type of Contractor			
Procurements/Contracts			
Item Name		12G	H
FY Procured		12G	(E12)
Cost - Services	(18B)	(11E)/12G	(H)/(E12)
- Materials	(18B)	(11E)/12G	(H)/(E12)
Estimated Delivery Date		12G	
Critical Path to Work (?)			
Plant Account Funds (?)			
Special Facilities			
Space Requirements			
Specialized Equipment			
Type			
Location			
Safety Requirements			

NOTE: Number/letter combinations indicate data blocks on the specified form (see Appendix A). Parenthesized symbols indicate derived data blocks.

Table 2
(Continued)

Major Management Document			Source
PAF	Staff	Other	
		Management Review	Package Author, Research Program Office
		Distribution Distribution	Internal Computer File
		Distribution	Package Author
			Package Author
		Supply Division Alert	Package Author
32		Supply Priorities Management Review	
33 33			Package Author

Table 2
(Continued)
Work Unit Package Data Elements

Data Element Title	Major Management Documents		
	DD 1498	LPS	A-1
Personnel Assignments			
Last Name			I
First Name			I
Code			
Title			
Social Security No.			
Telephone			
Skills req'd / year (code)			
Man Weeks req'd / year			(I)
Overtime required / year			(I)
GS Grade			
GS Step			
Series			
Salary			I
Pay Number (or other internal)			I
Financial Data			
Shop Pay / year			E5
Shop non-pay / year			E6
Other pay / year			E7
Other non-pay / year			E8
Laboratory computer time			(E7),(E8)
Publications			(E7),(E8)
Travel			E3
Materials & Misc. (Items < $5K)			E3
General Administrative			E9
Division Indirect			E10
Major Contracts / Procurements		11E	E12
Sub-total Labor Cost			
Total (sponsor funded)	('8E)		E13
Additional requirements			
Total Required			
Funds Received		11F	
Date			
Order No.			
Amount			
Total Internal Funds Allocated			
ONR Funds / FY			
Total Funds Available		11G	

NOTE: Number/letter combinations indicate data blocks on the specified form (see Appendix A). Parenthesized symbols indicate derived data blocks.

Table 2
(Continued)

Major Management Documents			Source
PAF	Staff	Other	
		Management Review	Package Author
(31)	3		
(31)	3		
	3		
	3		
12			
13			
	3		
	3		
	3		
		Management Review	Package Author
15			
16			
17			
18			
(17)(18)			
(17)(18)			
(14)			
(14)			
19			
20			
22			
23			Budget Office
24			
24			
24			

Table 2
(Continued)
Work Unit Package Data Elements

Data Element Title	Major Management Document		
	DD 1498	LPS	A-1
*Technical Descriptions			
Objective - short	23		E-1
- long		12B	
Approach - short	24		E-1
- long		12C	
Progress - short	25		
- long		12D	
Keywords	22		
Background/Technical state-of-art		12A	
References		12A	
Plans/Milestones		12E	
Related or Dependent Efforts		12A	
Similar Efforts		12A	
Problems Encountered			
Distribution Information	8A		
Release allowed to:			
LPS		Heading	
1498 (DDC or NARDIS)			
Sponsor			
Contractors	8B		
Proposal			
Last Report Submitted(sequence):			
LPS			
DD 1498	2,3		
Sponsor			
Proposal			
Contracotrs			
Time-sharing Service			
Microfilm Service			

NOTE: Number/letter combinations indicate data blocks on the specified form (see Appendix A). Parenthesized symbols indicate derived data blocks.

* Precede each starred data elements with its security classification.

Table 2
(Continued)

Major Management Document			Source
PAF	Staff	Other	
30		Management Review	Package Author
		Used to determine update requirements	Report Generators

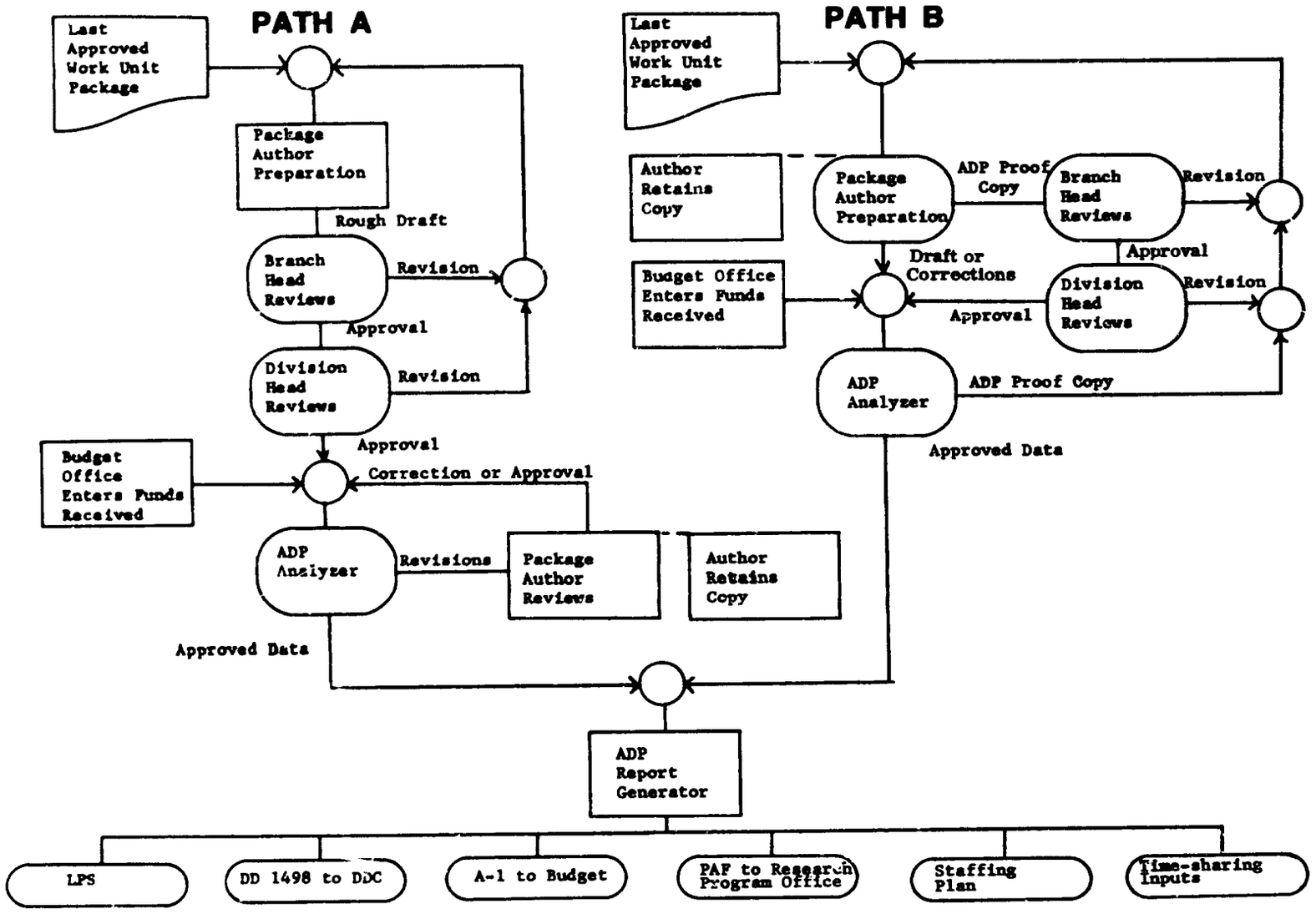

Fig. 5 - Propoded Procedures

- Data approval
- ADP integrated data base
- Report generation

The first five of these items will be outlined here; the latter two are discussed in the following sections.

5.2.1 Preparation by Package Author--The package author must allocate time for preparation of the proposal, for specifying information available after initiation of sponsorship, and for fulfilling updating requirements. Normally a proposal involves a high level of concentration on the textual portions of the package--enough to sell a project. Many data elements (e.g., specific personnel assignments and financial information) are unavailable to the degree of detail needed in the Work Unit Package. Sufficient reporting options can be made available from the ADP stored proposal information to disseminate that information required by prospective or predetermined sponsors (see Section 5.4, Report Generators, for report options).

When a program receives sponsorship, identification numbers, specific names and addresses, and manpower specifications will be detailed. Some of these may be supplied by the author of the initial submission or his replacement for fulfilling the reporting requirements. Some of the data elements may be inserted by the Research Program Office and the Budget Office. For those projects with a proposal in the data base, the textual portions may remain with little or no editorial modifications; those units not in the system as a proposal may have complete data entry when sponsorship is initiated. Legibly handwritten information will be accepted at the data-capture station.

On-going efforts may be documented by penciling changes, as they occur, on the author proofcopy of the previous entry, and submitting them periodically for data capture as policy dictates. Routine changes are centered in the areas of progress and financial adjustments; penciled revisions or typed inserts will be accepted at the data-capture station. Additional proofcopies for update will be made available upon request, or copies can be made locally for additional working sheets.

5.2.2 Branch Head Review--Branch Heads may give approval signatures on the penciled version of the Work Unit Package, as shown in Path A of Fig. 5. If this procedure is unacceptable, author proofcopies may be circulated as shown in Path B.

5.2.3 Division Superintendent Review--The Division may give approval on either the handwritten version or the author proofcopy. The automated system can provide a Division sets of Work Unit Packages for which it is responsible or with which it is associated in the form of either a proof-book or microfilm images (see Appendix D, Output Media Survey).

5.2.4 Data Capture--Information submitted by a package author is captured on a data recording device. Input device types and cost analyses are described in Appendix C, Data Collection Techniques. Output media are detailed in Appendix D, Output Media Survey. For the NRL prototype system, a general-purpose device will be investigated. The hardware procurement specification is included as Appendix F of this report. This terminal will serve all functions necessary in maintaining and disseminating work unit information, including:

- Edit and capture data in computer-compatible form
- Communicate with time-share management information systems on-line
- Communicate with time-share mathematical services on-line.

This same terminal can be made available for the latter two functions in connection with routine scientific needs.

The data-collection terminals shall have available, in computer-readable form, the current information for all Work Unit Packages for all authors the station is to serve. Thus, a package author needs only to submit his revised proofcopy to this station for a simple edit-update (see Appendix F for the specification of the editing facilities at the terminal). The work-package author initiating a new unit would be given the opportunity either of obtaining initial forms and instructions from a central agency locally designated at the individual laboratory, or of working directly with the data-capture device. The device will be able to operate in a prompting mode for this purpose.

Prompting information and the promulgated instructions will be as extensive as necessary to set standards for a uniform product of high quality. For example, if the next item to be captured is 'objective', an outline will be provided to indicate the type of information desired. This outline can be as extensive as is practicable--it could outline a series of questions that must be answered by the text, reminders of regulations that must be met (e.g., show relevancy to Navy needs, etc.) or other pertinent information. As the data-capture system gains sophistication, prompting could include additional guidelines for specific research areas.

It is assumed in this report that a computer-readable form of the Work Unit Package is returned to the data-capture station at the same time that the author proofcopy is routed back to the package author. The last approved information and update information will be returned as separate units for those packages needing correction of submitted material, so that the author can have complete flexibility in his choice for a starting point for the next submission.

The first two functions of the data-capture terminal are discussed elsewhere in this report; potentialities of the latter two functions in the package preparation are explored here. At NRL an unconscionable amount of time is expended in the mechanical tasks of equating project resource requirements to financial support. Interactive programs should be provided so that, for example, a package author can specify individuals by name, or GS grade, and manweeks, and receive a summary indicating manweek cost, overhead, and totals. In addition, the author should have the ability to designate internal publication requirements (e.g., a 100 to 200 page formal report with 5% of illustrations) and other cost-center requirements (e.g., 200 hours of computer time and 4 manweeks of computer programming assistance) and receive cost breakdowns and summaries. Then alternative configurations may be explored to fit the funding level desired, or additional funds can be requested based on the conducted study. Cost components could be dynamically updated at this central facility (e.g., Division indirect, cost-center cost, etc.) accessible to all users, rather than fostering the current 'dart-board' approach. The author/principal investigator can obtain more realistic and consistent planning figures and management can have confidence in cost derivations. This area of exploration will be addressed fully in a later phase of the NRL development.

5.2.5 Data Approval--Two approaches are possible in recording approvals of initial or corrected Work Unit packages. A requirement may be made that the package author is not allowed to submit information to the data-collection device until all approvals are received on the routing sheet used normally for internal routing. The package author is then the responsible individual for assuring proper management review. Alternatively, approval could be made by Branch and Division personnel by signing a computer-readable card which may remain on file for the duration of that update sequence or longer if required. This card would be submitted to the ADP facility before any information, insertions, or corrections would become available to the report generators. Either method can be made effective within a given laboratory.

5.3 Maintenance of Data Integrity

Maintenance of the integrated data base will require six major areas of consideration:

- Basic input routines
- Data element validity checks
- Data consistency
- Error diagnostics
- Author proofcopy
- Update calls

Input routines will be developed to handle the computer-readable data captured from the program package author and from other sources such as the Budget Office and Research Program Office. It may be determined that all of these will be handled through the same input media, or through a variety of combinations. The basic function of these routines is to accept information in the computer memory and perform any necessary conversions (e.g., BCD to binary, etc.) to make it conform to individual storage requirements of a given data-base element.

As a data element is recognized at the computer, specific validity checks will be made on it to assure proper format. Errors found in this processing are remembered, and analysis continues until all data elements of the submission have been examined. The existence of at least one error will cause diagnostic notations to be appended to the author proofcopy. Errors in format or in critical data blocks will cause the received input information to be made unassessible to report generators until those data elements in error are corrected, or until a specific override command is given by the package author. Approvals are required in all cases, but errors delay the information release to the integrated data base.

When the submitted data are all assembled in internal format, consistency checks will be made among all of the data elements of the Work Unit Package as updated. These diagnostics will be designed to help pinpoint possible errors in either data preparation or number/funding assignment. Although these diagnostics are relayed to the author, ambiguity annotations will not, in general, demand author action and will not delay system acceptance of the data when management approval is received. Examples of this type of inconsistency might be seen between the 'element/appropriation' data element and the 'type of research' data element, or between planning resource enumerations and funds expected.

At the conclusion of the processing of information on a Work Unit Package by the ADP system, an author proofcopy will be returned to the package author along with a data status notation. This notation will be one of:

1. Information accepted, integrated into master data base

2. Information accepted and integrated, but note possible ambiguities

3. Information accepted, awaiting approvals

4. Information accepted, awaiting approvals, but note possible ambiguities

5. Information in error, awaiting package author correction.

If data submission includes inherent approval (Path A of Fig. 5), one of the first two notations will appear if no errors are encountered in ADP

processing. The third or fourth notation is provided when signature cards are required (Path B of Fig. 5), but ADP processing found no serious error.

The author proofcopy in these first four data status notations will reflect the updated Work Unit Package in its entirety--inconsistency annotations will be appended in notations two and four. These notations require no corrective action, although the author may desire to do so in a later edit cycle. Through experience, it may be found that certain inconsistent combinations will necessitate the inhibiting type of error procedure to be initiated automatically. The fifth data status notation would be appended to the proofcopy in which at least one major error has been detected. In this instance, the last approved proofcopy will be included with the corrected version. Thus the author may begin anew, or he may merely correct that portion of his submission that caused the error(s).

Whenever information is held apart from the integrated data base, either awaiting approval or correction, memorandums will be automatically generated at designated intervals and disseminated to those people identified as causing the delay. After some maximum time limit, intermediate storage holding invalid updates will be removed, and the author will be required to submit his insertion or correction anew.

The primary concern of all managers is the timeliness of the information available to them. The data base will be periodically searched to determine update requirements. These include such data elements as the last time changes were made (or an update verification was received) and receipt of funds in excess of stated expected values. Determination of these states will cause a memo to be transmitted to the package author as a call procedure for update. This procedure could be repeated at designated intervals until some communication is established.

5.4 Report Generators

Once a data base is developed and procedures are enforced to assure its maintenance, any report can be generated with a minimum amount of confusion and effort. There are three major classes of reports that will be addressed in the NRL effort:

- The externally required document
- The internal planning document
- Tailored management reports.

5.4.1 External Requirements--Examples of this requirement are the DD 1498 and the LPS. It is here proposed that this class of report generators should be developed by the agency initiating the requirement (or the Naval Directorate) for use universally through the laboratories.

For example, CNM is the responsible Naval agency for assuring laboratory reporting of the DD 1498 calls to DDC. Thus, if changes are deemed necessary, CNM should be the responsible Naval Command for altering the general-purpose report generator and for promulgating it to the laboratories. This effort can be accomplished either by capabilities within CNM or by use of a committee of representatives from each laboratory. The committee could serve as a sounding board for proposed changes and could delegate the generator maintenance responsibility among its members. These generators will be based on a set of data-element definitions such as those shown in this report. Each element will have an associated location within the data base and the mode in which it is stored (i.e., binary, BCD, etc.). Once the basic data set is determined, it is hoped that information necessary for reports may be obtained directly or easily derived.

It is proposed that these report generators be written in some high-level language, preferably FORTRAN or COBOL. NRL would suggest the former, as FORTRAN is available on all computers regardless of their age. If some basic set is used, it will require the minimum tailoring to anyone laboratory ADP installation. Once the required information is collected, the material can be:

- Formatted on a tape for centralized microfilm generation
- Printed on the local line-printer
- Formatted for centralized publication
- Transmitted directly to the requestor's ADP equipment.

Appendix D details these options.

In its current effort, NRL plans to develop generators for the DD 1498 and the LPS and will subsequently make them available to the other naval laboratories and CNM/DNL. As future requirements develop, the generators may be replaced entirely or altered as necessary. Thus top management can operate effectively in a dynamic situation with a minimum of reinvention at the laboratory level, and with no diversion of the package author/principal investigator from his primary function.

5.4.2 Internal Requirements--Traditionally, a number of function-oriented internal documents have been used for planning information at various levels. Ultimately, it is hoped that these pieces of paper will be replaced by an integrated data base interrogated by time-sharing management systems, or at least an inter-data base communication to reduce the flow of paper. In the interim, the major documents described in this report will be produced by line printer and automatically routed to the activity levying the requirement. If enough interest can be generated among the laboratories, the task of writing these generators can be shared to the benefit of all participants. It is understood, however, that in many instances, some individuality will be required.

5.4.3 Dynamic Requirements--In the next Section, and in Appendix E, the use of on-line query abilities will be discussed. It is hoped that this capability can be used by people in upper managerial positions to determine meaningful answers to daily managerial problems as well as the explosive crisis situation. They may browse at leisure through the entire information available. When refined responses emerge requiring lengthy computer runs or voluminous printouts, production runs may be batched from the query facility. Alternatively, a generator can be developed as in the previous two Sections. If enough use if made of the generator, it may become one of the 'battery' of internal requirements automatically initiated at predesignated intervals or in an 'on-call' basis. It is the goal of the system to provide maximum information with a minimum of effort.

5.5 Query Processing

Management-information systems are expensive to develop and maintain--more expensive than a single laboratory can affort in either monetary or manpower resources. Several systems are currently on the market. NRL has followed the developments of several of these. The Naval Electronics Laboratory Center (NELC) in San Diego is evaluating GIM[2], TDMS[3], and SACCS/DMS[4] for use in command/control systems.

In 1969, NRL made extensive use of TDMS, which was developed under Advanced Research Project Agency (ARPA) sponsorship. The principal virtues and disadvantages of TDMS are:

ADVANTAGES

- The retrieval language is very easy to learn and use
- Full inversion file structure permits efficient retrieval (at least potentially) on any set of data element value conditions
- The data base description language permits the simple description of a logically complex tree-structured data base
- The report generation specification language is easy to use.

DISADVANTAGES

- Report generation is slow
- Data base update procedures are slow and awkward
- Interfacing the system with new procedures written in general procedure-oriented languages is difficult
- Relations between stored values are not allowed as a retrieval condition.

• Each entry in a single file must have the same logical structure, and multiple files cannot be accessed simultaneously

• It is not possible to waive inversion on values of fields tnat would never be used as retrieval keys

• Complex specifications are not remembered and must be repeatedly entered while browsing.

In 1968, a Strategic Air Command (SAC) team conducted a study to determine usefulness of TDMS to SAC requirements. The result of this study was a plan[5] which has, in general, been followed with the work prosecuted by a team of SDC analysts, SACCS officers with remarkably good technical skills, and SAC officers representing the ultimate user of the system. It is noteworthy that because of the high technical competence of the Air Force team, they have been able both to run the contractor and to make significant technical contributions. Most of the deficiencies listed have been corrected and several new features added.

SACCS/DMS appears to be a leading candidate for an on-line management-information system for government agency use. This conclusion is based on the following considerations:

1. The outstanding technical characteristics of the SACCS/DMS-70 system

2. The strong possibility that development will proceed on a SACCS/DMS-71 system with financial support from other segments of the Air Force, even if SAC is satisfied with the SACCS/DMS-70 system

3. The relative ease of conversion of the system to other computers (an initial SAC design goal) and the SAC plan to convert it to operate on the first WWMCCS machine

4. Complete government ownership of the system

5. Government in-house competence in the system, allowing close control of any contractors that may be used in a support role.

6.0 CONCLUSIONS

NRL hopes to enhance its scientific output by aiding its personnel and programs as follows:

1. Package Author/Principal Investigator

• All aspects of the required information will be incorporated into a single reporting package--the Work Unit Package

• All data elements will be required to be consistent within a report before it is unconditionally accepted--ambiguities will be flagged

- ADP will help remind the author of update needs

- The author will be made confident of system capture in input information

- External reporting requirement changes usually will not affect the author

- Revisions are so easily accomplished that technical quality should improve.

2. Secretarial/Editorial Functions

- The most lengthy preparation will be at proposal or initial report time; all subsequent submissions will be an edit function on captured information.

- If technical and grammatical quality are not acceptable, the information may be easily viewed and edited by pertinent staff, even editorial staff if required, at the data-capture station.

3. Publications

- Uniform publishable-quality copy can be obtained in one pass of the required report generator for the required output media

- Microfilm will be easily obtainable through direct use of COM equipment.

4. Supporting Staffs

- Alerts can be routed to the supporting activities required in advance, so that those activities may plan ahead for the bulk of the work required.

5. Managers

- External requirements and routine internal requirements will be met automatically and can be made dynamic to reflect changing needs without affecting the information sources

- Many crisis situations can be solved rapidly by on-line query of the stored data base

- Duplicative and supporting work can be quickly recognized.

NRL has not solved all of the problems defined in this report. The terminal is undergoing final procurement actions (see hardware specifications

in Appendix F). An initial formalized data base is nearly completed. Immediate concern will center around data-collection and verification techniques for information entered initially and in the update cycle. By early spring, the model will be tested on a limited basis within NRL and will include the report generators for the LPS and the DD 1498.

We welcome suggestions from individuals and from laboratories with similar needs.

REFERENCES

1. "DOD Instruction 7720.13" of 16 April 1968, Subj: Research and Technology Work Unit Information Systems.

2. "GIM (Generalized Information Management) User's Manual," TRW Systems Group, TRW Document No. 3181-C, Revision 01, 15 August 1969.

3. "TS/DMS User's Guide - Commercial Data Management System," Commercial Products Department, Commercial Systems Division, Systems Development Corporation, Technical Memorandum - TM-4132/000/02, 1 May 1969.

4. Curtis, R.G., "Description of the SACCS Data Management System," The Miter Corporation MTR-1869 (Air Force Electronic Systems Division ESD-TR-70-295), September 1970.

5. Osajima, Y.R., Thomas, D.L., McKusick, LT COL C.E., "SACCS/TDMS Compatability Study," System Development Corporation Technical Memorandum TM-3941/0000/00, 31 July 1968.

6. "Keyboard-to-Tape Input Systems," Modern Data, January 1969.

7. Murphy, W.J., "Cassette-Cartridge Transports," Modern Data, August 1970.

8. Wooster, H., "Microfiche 1969 - A User Survey," Air Force Office of Scientific Research, Arlington, Virginia, July 1969. Clearing House AD 695049.

9. Harmon, G. H., "Computer Output Microfilm (COM) Devices - A survey of COM devices: what they are, how they work, and where they are used," Modern Data, November 1969.

10. "Time-Sharing Services," Modern Data, February 1970.

11. Falor, Ken, "Survey of Program Packages - Report Generators and File Management Systems," Modern Data, August 1970.

APPENDIX A

NRL MANAGEMENT STRUCTURE

Figure A-1 depicts the line structure of that part of NRL directly responsible for the prosecution of RDT&E. The upper half of each box names the organizational component; the lower half names the title of the head of the component. Alternative terms used at other Laboratories/ Centers are listed on the right.

Figure A-2 shows the relations between the various identification numbers which refer to RDT&E work units. The following definitions apply:

NRL Problem No. An identification number assigned to a work unit or to a group of work units commonly managed. Consists of a letter and two digits identifying the technology and applications area, and two additional digits for uniqueness.

APPROXIMATE SYNONYM (Customer Order Number)

Job Order No. An identification of the basic accounting entity. Consists of a NRL Problem No. prefixed by a division code.

Point Numbers. A three-digit code attached to a NRL Problem Number to provide a unique identification in NRL Problem Number format to a work unit that is part of the NRL Problem. The first digit identifies the sponsor; the other digits provide uniqueness.

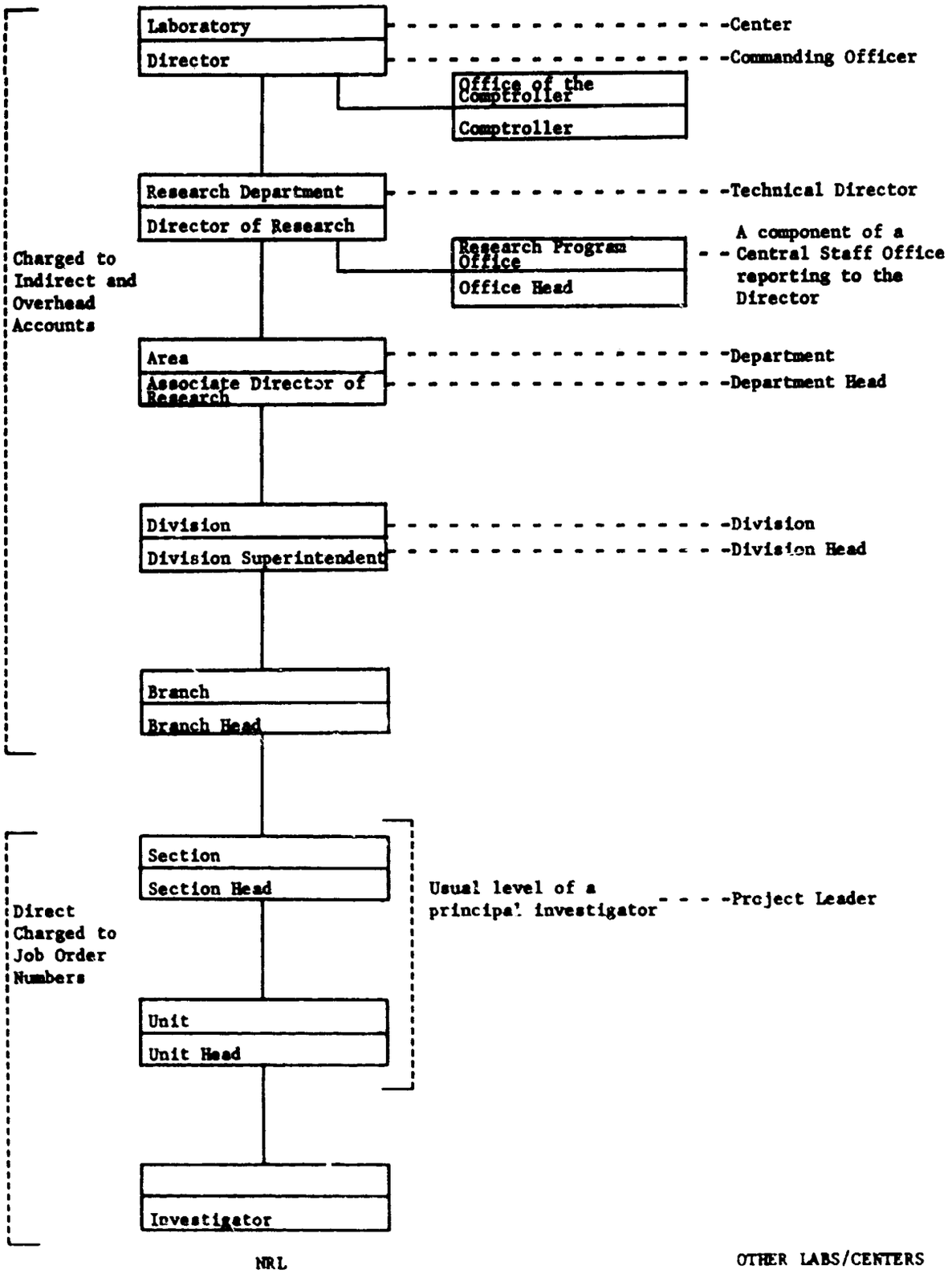

Fig. A-1 - Laboratory Line Structure

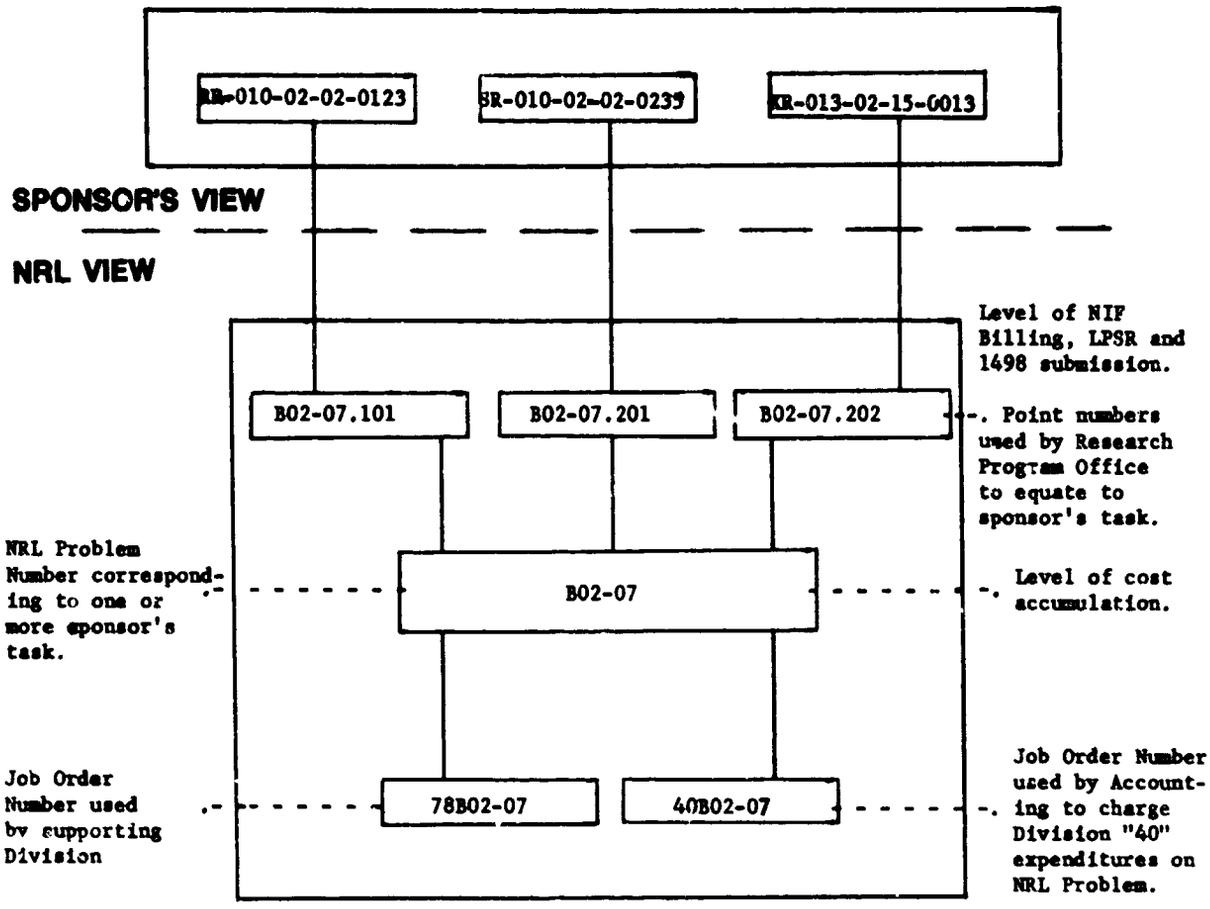

Fig. A-2 - Work Unit Identifications

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APPENDIX B

MAJOR SOURCE DOCUMENTS

The following pages are copies of the major reporting documents within NRL. A sample of other reports required are:

- A-2 Branch and Division Budget Summary
- A-3 Special Purpose Major Procurement Priority List
- A-5 Foreign Travel
- A-6 Summary of Research Associates
- B-1 Research Division Estimate of Indirect Costs
- B-2 Division Request for Plant Account Funds

Most of these latter reports are not filled at the level of the principal investigator but much of the information can be derived by the collection of the reports of all principal investigators.

RESEARCH AND TECHNOLOGY WORK UNIT SUMMARY

1. AGENCY ACCESSION*	2. DATE OF SUMMARY*	REPORT CONTROL SYMBOL

3. DATE PREV SUM'RY	4. KIND OF SUMMARY	5. SUMMARY SCTY*	6. WORK SECURITY*	7. REGRADING*	8a. DISS'N INSTR'N	8b. SPECIFIC DATA: CONTRACTOR ACCESS ☐ YES ☐ NO	9. LEVEL OF SUM A. WORK UNIT

10. NO/CODES:*	PROGRAM ELEMENT	PROJECT NUMBER	TASK AREA NUMBER	WORK UNIT NUMBER
a. PRIMARY				
b. CONTRIBUTING				
c. CONTRIBUTING				

11. TITLE *(Precede with Security Classification Code)**

12. SCIENTIFIC AND TECHNOLOGICAL AREAS*

13. START DATE	14. ESTIMATED COMPLETION DATE	15. FUNDING AGENCY	16. PERFORMANCE METHOD

17. CONTRACT/GRANT

a. DATES/EFFECTIVE: EXPIRATION:

b. NUMBER:*

c. TYPE: d. AMOUNT:

e. KIND OF AWARD:

18. RESOURCES ESTIMATE		a. PROFESSIONAL MAN YEARS	b. FUNDS *(In thousands)*
FISCAL YEAR	PRECEDING		
	CURRENT		

19. RESPONSIBLE DOD ORGANIZATION

NAME:*

ADDRESS:*

RESPONSIBLE INDIVIDUAL

NAME:

TELEPHONE:

20. PERFORMING ORGANIZATION

NAME:*

ADDRESS:*

PRINCIPAL INVESTIGATOR *(Furnish SSAN if U.S. Academic Institution)*

NAME*:

TELEPHONE:

SOCIAL SECURITY ACCOUNT NUMBER:

21. GENERAL USE

ASSOCIATE INVESTIGATORS

NAME

NAME:

22. KEYWORDS *(Precede EACH with Security Classification Code)*

23. TECHNICAL OBJECTIVE,* 24. APPROACH, 25. PROGRESS *(Furnish individual paragraphs identified by number. Precede text of each with Security Classification Code.)*

*Available to contractors upon originator's approval

DD FORM 1 MAR 68 1498 STOCK NO. 0102-014-9300 PREVIOUS EDITION OF THIS FORM IS OBSOLETE. GPO 867-850

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LABORATORY PROGRAM SUMMARY

Security Classification and Downgrading	Laboratory Name: NAVAL RESEARCH LABORATORY Address: WASHINGTON, D.C. 20390 Date:
1. Sponsor's Assignment Number	2. Title
3a. Element/Appropriation	3b. Sponsoring Command/Activity
4. Prior Identification Number/Title	
5. Sponsor's Program Manager/Code	
6. Sponsor's Technical Agent/Code	
7. Kind of Summary ☐ Plan/Progress ☐ Proposal	8a. Other Participating Sponsors
8b. Estimated Completion Date	9. Lab Identification Number
10. Principal Lab Investigator(s) Codes Names Phones	

11. Manpower and Cost Estimates *Applies to CNM activities only	CFY-1	CFY	CFY+1	CFY+2
	19	19	19	19
a. Technical Man-Years				
*b. Total Direct-Labor Man-Years				
*c. Total Labor and Overhead $K				
*d. Materials and Travel $ K				
e. Major Procurements/Contracts $ K				
f. Planning Estimate $ K				
g. Funds Available $ K				

12. Other Information

Information to be included in this block are
a. Background
b. Objective
c. Approach
d. Progress
e. Plans and Milestones
f. Reference (Recent Reports)
g. Major Procurements/Contracts

Security Classification and Downgrading

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PROBLEM ACCEPTANCE
NDW-NRL-3920/4002 (Rev. 6-68)

1. PURPOSE *(Check one)*

A. ☐ NEW NRL PROBLEM

B. ☐ NEW WORK UNIT _____
UNDER NRL PROBLEM _____

C. ☐ CONTINUATION OF WORK UNIT _____
UNDER NRL PROBLEM _____

INSTRUCTIONS

UNDER 1A AND 1B COMPLETE 4 COPIES, RETAIN 1 FOR FILE AND SEND 3 TO CODE 4010VIA 2900 AND 3100. UNDER 1C COMPLETE 1 COPY AND SEND TO CODE 4010.

11. ESTIMATED DURATION *(years)*

TO BE COMPLETED BY RESEARCH PROGRAM OFFICE ONLY

2. SERIAL NO.	3. NRL PROB. NO. ALLOCATED
4A. COGNIZANT DIVISION	4B. COGNIZANT BRANCH(S), PRINCIPAL INVESTIGATOR
5A. COOPERATING DIVISION	5B. COOPERATING BRANCH(S)

6. TITLE OF NRL PROBLEM/WORK UNIT

7. SPONSOR	8. SPONSOR'S IDENT. NO.

9. SPONSOR'S WORK UNIT TITLE

10. BASIC REFERENCE DOCUMENTS, ENCLOSURES

MANPOWER AND COST ESTIMATES

1A. COMPLETE ALL ITEMS.
1B. ENTER MW LINES 11 & 14, AMOUNTS LINES 20, 21, & 22. ROUND AMOUNTS TO $100's & EXPRESS IN THOUSANDS.
1C. THIS SECTION NOT REQUIRED.

	THIS YEAR FY ____		NEXT YEAR FY ____		NEXT YEAR FY ____	
	MW	AMOUNT	MW	AMOUNT	MW	AMOUNT
DIVISION ROUTINE COSTS:						
12. STRAIGHT TIME PAY						
13. OVERTIME						
14. MATERIALS, TRAVEL & MISC.						
SERVICE DIVISION SUPPORT:						
15. ESD PAY, ETC.						
16. ESD NON-SALARY COSTS						
17. OTHER PAY ETC. (PW, CBA, ETC.)						
18. OTHER NON-SALARY COSTS						
APPLIED OVERHEAD:						
19. GEN. AND ADM.						
20. DIVISION INDIRECT						
21. SUBTOTAL ROUTINE LINES (12) THROUGH (20)						
22. MAJOR CONTRACTS & PROCUREMENTS.						
23. **TOTAL** (LINE 21 + 22)						

24. SOURCE OF FUNDS

RESEARCH DIVISION ESTIMATE	INITIALS			
BUDGET DIVISION	INITIALS			
25. SPECIFY PROBLEM(S) ON WHICH ABOVE SCIENTIFIC MAN WEEKS WERE INDICATED ON PREVIOUS "A-1" OR "PAR" FORMS				

26. ARE SPONSOR'S REPORTING REQUIREMENTS SATISFACTORY?
☐ YES ☐ NO

27. SECURITY CLASS.
NRL PROB. _____
WORK UNIT _____

28. PRIORITY
NRL PROB. _____
WORK UNIT _____

29. SUPPORT SERVICES MANPOWER

ESD	INITIALS
PWD	INITIALS
OTHER	INITIALS

IF ANSWER TO ANY OF THE QUESTIONS BELOW IS "YES" GIVE DETAILED EXPLANATION ON A SEPARATE SHEET.

30. WILL THIS EFFORT INTERFERE WITH ANY COMMITMENTS OR WITH WORK NOW IN PROGRESS?
☐ YES ☐ NO

31. WILL ADDITIONAL PERSONNEL BE REQUIRED?
☐ YES ☐ NO

32. WILL NRL HAVE TO PROCURE ADDITIONAL PLANT ACCOUNT EQUIPMENT?
☐ YES ☐ NO

33. WILL ADDITIONAL SPACE AND/OR FACILITIES BE REQUIRED?
☐ YES ☐ NO

SIGNATURES

COOPERATING DIVISION SUPERINTENDENT	DIVISION	DATE	COGNIZANT DIVISION SUPERINTENDENT	DIVISION	DATE
RESEARCH PROGRAM OFFICER		DATE	DIRECTOR OF RESEARCH OR ASSOCIATE		DATE

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PROBLEM ACCEPTANCE
NDW NRL-3920/4002 (Back)

INSTRUCTIONS

For NRL originated work fill in all items. For other initiated efforts fill in items "A", "B", "C" and "E (1) + (2)". For work continuation under existing problem (1C), this side need not be filled in.

A. NRL FIELD PROGRAM (SEE NRL REPT 6060)	B. COOPERATING CODES

C. ABSTRACT

D. REQUIREMENT AND JUSTIFICATION

E. BRIEF OF NEW WORK

(1) OBJECTIVE

(2) APPROACH

GPO 943-711

FORM A-1 JOB ORDER ESTIMATE (FALL, FY 1971)

A. Title:	B. Branch	C. Job Order

D. For 3100 USE:	SPONSOR'S IDENTIFICATION NO.

E. BUDGET ESTIMATES: Round estimates to nearest $100 and express in thousands

COST ELEMENT	Jul-Dec 1970		Jan-Jun 1971		Jul'71-Jun'72		Jul'72-Jun'73	
	MW	Amount	MW	Amount	MW	Amount	MW	Amount
DIVISION ROUTINE COSTS: 1. S-T Pay + Fringe Benef								
2. Overtime								
3. Materials & Misc.								
4. Travel								
SERVICE DIVISION SUPPORT: 5. ESD Pay etc.								
6. ESD Non-Salary Costs								
7. Other Pay etc. (PW, CBD, etc.)								
8. Other Non-Salary Costs								
APPLIED OVERHEAD: 9. Gen. & Adm.								
10. Division Indirect								
SUBTOTAL ROUTINE 11. Lines (1) through (10)								
MAJOR CONTRACTS 12. & PROCUREMENTS								
TOTAL 13. (Line 11 + Line 12)								

BELOW THIS LINE FOR CODE 3100 USE ONLY

	Initial Budget	FY 1971 EXTRAP	Division Request FY 1971			Proposed Budget FY 1971		
			ONR	Other	Total	ONR	Other	Total
Reg. M-Y								
Rout/ M-Y								
Routine								
Maj. Proc.								
Total								

BRANCH _____ JOB ORDER _____

F. SOURCES OF FINANCIAL SUPPORT:

Please supply support information below. Funds for separate tasks from the same Sponsor should be identified separately.

Command or Agency	Amount Required			Cognizant Sponsor's Code	
	FY 1971	FY 1972	FY 1973	Code	Name
REGULAR ONR				[redacted]	
TOTAL					

G. COMMENTS RE FINANCIAL SUPPORT, CO-OP JOBS, ETC.

H. MAJOR CONTRACTUAL SERVICES AND PROCUREMENTS

Item	FY 1971		FY 1972	FY 1973
	1st 1/2	2d 1/2		
TOTAL (Same as Line 12)				

I. DIVISION PERSONNEL FOR FY 1971

Pay Number & Name	MW	Ann. Sal.
TOTAL MW FY 1971		[redacted]

WORK SHEET FOR DEVELOPING STAFFING PLAN

1. Branch or Office

2. Plan No.

3. Name; Current Position Title, Series and Grade; P.D. No.; and Organizational Code	4. Proposed Action	5. Explanation or Justification for Proposed Action	6. Proposed Effective Date

7. Signature, Title and Date (Branch or Office Head)

APPENDIX C

DATA COLLECTION TECHNIQUES

Collection techniques depend on the media utilized. Numerous varieties of equipments are available. Three techniques are briefly reviewed to show the range of capabilities and pricing of readily available equipments. In the cost analysis, labor costs are computed for efforts necessary in the capture of the data. Since the same supervisory personnel are required regardless of the input mode, their cost is not considered here.

1.0 CARDS

Card-processing equipment is readily available at most laboratory computing facilities. Although the data card is relatively inexpensive to produce, it is not easily understood by many managers and represents an irritation to those individuals who want any automated system to conform to their thought processes rather than to readjust their thought processes to a system imposed upon them. The major procedural disadvantage of cards is the long delay which must be endured between the submission of a draft and the receipt of the card-produced proof copy of the information submitted.

Since most computer installation managers prefer to avoid maintenance of large pools of keypunch operators, this report assumes use of a commercial cardpunch service at the rate of ten cents per card.

1.1 Cost estimate for work package submission:

1.1.1 Materials--Initial entry/edit.

300 cards	punching	$30.00
	computer reading	.60
	total	$30.60

Update entry/edit.

100 cards	punching	$10.00
	computer reading	.20
	total	$10.20

Average rate $20.40

If a total volume of 700 units per update is necessary, the cost would be $14,280.

1.2.2 Labor--This report assumes starting data capture from penciled revisions made on the author's proof copy. Since commercial cardpunch services require that the submission of data to be punched must be in a standard format, secretarial efforts must be utilized to prepare this information. There are two possible alternatives:

- Repunch entire submission (always necessary at the initiation of a new work unit)

- Repunch only those cards required to complete the update information and manually 'edit' the last submission.

Both of these methods required about the same amount of time. It is assumed that a fourth-step GS-3 is assigned who is burdened by 30% for leave, etc., but not subject to G&A or indirect burdens. This rate would be $3.60 per hour. If time expended is in the order of three hours per submission, 700 updates would cost $7,600.

1.2 Additional Utility

There is no additional utility.

2.0 SELECTRIC TYPEWRITERS WITH MAGNETIC CARD OR MAGNETIC TAPE

The augmented typewriter is very versatile, because all secretaries are familiar with the basic typewriter unit; additional training on magnetic card or magnetic tape techniques is modest. Captured data are not directly computer-readable. However, there is at least one vendor who can convert the stored information into computer-compatible form for on-line input to a computer via a communications circuit attached to the magnetic device.

2.1 Cost estimate for work package submission

2.1.1 Materials--Capital costs include:

A basic unit (magnetic card)	$7900.00
Conversion equipment	3600.00
Data set	400.00
Total cost per configuration	$10,900.00

Assuming existence of equipment, costs per submission include storage for 200-card images (average submission) would be four 50-track magnetic cards. For 700 units, a total of 2800 cards would be required for a total of $2520.00. Some of these cards can be reused for subsequent submissions and/or other functions.

2.1.2 Labor--Recording of an entire submission would require about three hours of secretarial effort; updates should require about two hours of effort. Assuming the 3.60 per hour rate described in Section 1.1.2, $7.20 to $10.80 would be required per submission. Using an average of $9.00 per submission, a laboratory-wide call of 700 units would cost about $6,300.

2.2 Additional Utility

The off-line equipment would prove useful for formal report generation and other functions requiring at least one cycle of draft. The

same device could be used for a receptacle for computer output of managerial information, but since transmission rates are slow, cost and time figures may become excessive and interruption of work in progress unacceptable.

3.00 CATHODE-RAY-TUBE DATA COLLECTOR/EDITOR/COMMUNICATOR

Recent literature shows that there is a development explosion for cathode-ray-tube terminals.[6] For the pilot model described in this report, at least one will be obtained which is capable of handling all of the proposed functions.

3.1 Cost Estimate for Work Package Submission

3.1.1 Materials--Recent procurement negotiations revealed prices, depending on unit sophistication, from $5000 to above $100,000. At least one vendor's prices showed relatively expensive units for the first few procured, but purchase of additional units in the range of $1000 to $2000. Cost of the media on which the information is captured, cassettes or magnetic tapes, is negligible (See Appendix D, Table D-1).

3.1.2 Labor--Entering a submission would required about two hours for initial entry and one-half hour for updating of information. An average of one and one-fourth hours of secretarial effort at a rate of $3.60 per hour would cost $4.20 per submission, or a total of $3150 for 700 units on a laboratory-wide call.

3.2 Additional Utility

The CRT data-capture configuration can be used to satisfy the needs of all scientific personnel as a substitute for card-punch and verification equipments, as an editing device for generation of technical reports, and as an on-line communicator to scientific and managerial time-sharing services.

4.0 COST COMPARISONS

Direct cost comparisons are difficult, since they are influenced by the number of terminals procured, which in turn is affected by the estimates of the time required to update a work package through a terminal. If we accept the estimates of the previous section, the minimum number of typewriter terminals (Option 2) to produce two 700 work-unit packages per year is two, and the minimum number of CRT terminals (Option 3) is one. However, these minimum numbers would require about four months for the processing of a package, unless secretarial services were available in a second shift. A more reasonable plan would be to procure four typewriters or two CRT terminals. If the terminals and their storage media are to be amortized over six years then the annual cost comparisons are:

	OPTION 1	OPTION 2 (2 terminals)	OPTION 2 (4 terminals)	Assumes a $9000 terminal and a $5.00 cassette OPTION 3 (1 terminal)	OPTION 3 (2 terminals)
Capital		$3633	$7267	$1500	$3000
Reusable		420	420	583	583
Labor	$25,560	12600	12600	6300	6300
Totals	$25,560	$16,653	$20,287	$8383	$9883

These figures should be treated with caution; indeed, the purpose of the pilot project is to refine the estimates on terminal productivity.

APPENDIX D

OUTPUT MEDIA SURVEY

Table D-1 summarizes some characteristics of output media of interest in management systems; the accompanying text identifies factors in cost derivations and auxiliary information. It is assumed that a general-purpose computer is available. A page is defined as 60 lines of 80 characters, or a total of 4800 characters.

A. MAGNETIC TAPE

Use of eight-bit characters to accommodate usage of upper and lower case alphabetics is assumed in the cost analysis. If recording densities are 800 bits per inch for seven-track tape and 1600 bpi for nine-track tape, 3600 and 9600 pages can be stored respectively. NRL currently charges $10.60 for the purchase of a 2400-ft reel of tape which is usable on either seven-track or nine-track equipment. Storage of a page would therefore cost around a quarter of a cent per page for seven-track, or a little more than one-tenth of one cent for nine-track recordings. If only scratch (temporary) storage is required, there is no cost to the NRL user.

Full upper and lower case capabilities are more easily obtained on nine-track tape. If only seven-track tape is available, input-output routines of the driving computer would have to be provided to convert the eight-bit characters in computer memory to the tape format suitable for seven-track storage, either through special encoding or splitting core-stored characters into fractional parts of tape characters.

Magnetic tape could be used as an intermediate storage medium for automatic generation of printing plates or for printing in conjunction with COM activities.

B. CASSETTES

Reference 7 discusses the features of many cassette recording equipments now available. The prices in Table D-1 reflect costs of the cassette equipment and the interfaces necessary to allow communication with a cathode-ray-tube data-collection device.

On the assumption that the cassette contains a 300-ft reel of tape with a storage capacity of 2×10^6 bits and that the cost per cassette is about $5.00, the cost per page of storage is about 10 cents. It may be desirable, however, to assign a cassette to each work package.

C. MAGNETIC CARD

Capital cost variations are dependent on the device used to transform the magnetic-card information to computer-readable data. The cost of magnetic cards is dependent on the quantity purchased.

TABLE D-1
OUTPUT MEDIA ANALYSIS

CHARACTERISTICS	MEDIA								
	Magnetic Tape	Cassettes	Magnetic Card	Punched Card	Computer Controlled Typewriter	COM	Hard Copy from COM	LP	LCLP
Capital Cost	None	$5K-$10K	$5K-$10K	None	$5K-$10K	None	None	None	$10K-$20K
Add'l Cost/Page									
Reusable	Negligible	$.10 up	$.90-$1.24	None	None	None	*	None	None
Committed	None	None	None	$.32-$.59	None	$.02	*	$.006-$.01	≤ $.01
Time to Produce a Page	<< 1 second	.5-5.0 minutes	.5-5.0 minutes	10-30 seconds	∼ 5 minutes	*	*	3-6 seconds	∼ 20 seconds
Full Code(?)	Maybe	Maybe	Yes	No	Maybe	Yes	Yes	No	Yes
Directly Human Readable	No	No	No	Maybe	Yes	Yes	Yes	Yes	Yes
Suitable for DDC Report	Yes	No	No	Yes	No	No	No	No	No
Suitable for LPS Publication	Maybe	No	No	No	No	Maybe	Yes	No	Yes
Suitable for Proof Copies	No	No	No	No	Maybe	Maybe	No	Maybe	Yes

* See text for these devices.

D. PUNCHED CARD

NRL currently charges $0.57 to $0.99 for each 500 computer-generated output cards, dependent on the priority of the job producing the data to be punched. Punched cards may be listed on off-line equipment available at most computer configurations. Legibility would depend on the sophistication of this device.

E. COMPUTER-CONTROLLED TYPEWRITER

The major disadvantage of a computer-controlled typewriter is the amount of time required to produce a page. Legibility would be a function of the ability to use upper and lower case characters and of the quality of the type font.

F. COM (COMPUTER OUTPUT MICROFILM)

References 8 and 9 discuss microfilm usefulness and the role of computers as a generator of microfilm.

Most laboratories do not have COM equipment. To acquire the equipment would mean an expenditure of $50,000 to $150,000; most laboratories do not have sufficient need to justify this amount of capital expenditure. However, COM services are available in most large cities. These services are relatively inexpensive ($0.03 per page for originals and $0.01 to $0.02 per page for microfilm duplicates); service can be accomplished within 24 hours on a routine basis.

It may be possible to distribute LPSR's to many of their users in the form of microfilm. This would ease the burden of bulky storage at locations such as laboratory libraries, etc. Whether or not this medium could help eliminate publications as they are now promulgated is difficult to determine. If good-quality proof copies could be obtained, perhaps they could be used to meet sponsor needs, and the microfilm could meet the more global requirements.

G. HARD COPY FROM COM

There are two options for producing hard copy from microfilm. For a small number of copies, the image can be enlarged and reproduced by various duplicating processes at a cost of $0.04 to $0.05 per page.

If more copies are required, a Bruning master can be made for about $0.50, or metal plates for about $2.20 each, and the copies run on multilith for an additional $0.01 per copy.

H. LINE PRINTER (LP)

Line printers are an integral part of almost every computer installation. While the pages of print are inexpensive to produce, they vary in quality, dependent not only on the printing mechanism in the equipment

(impact or electrostatic) but also on the amount of time that has passed since the last routine maintenance (low charge, worn ribbon, etc.). Many managers also have a prejudice against the usual line printer, perhaps because poor quality is being imposed upon them. Most managers like to see text as it would appear from their secretary's typewriter.

I. LINE PRINTER WITH UPPER/LOWER CASE CHARACTERISTICS (LCLP)

Few laboratories have line printers with full alphanumeric capabilities. The purchase price is included in Table D-1 as an indicator of potential capital requirements.

The LCLP is inexpensive per page of print and is highly legible. It affords the manager as well as the scientific technical author an excellent tool. It is hoped that the LCLP can be maintained sufficiently well to assure publishable products on a routine basis.

APPENDIX E

ALTERNATIVES FOR PROVIDING QUERY CAPABILITY

1. METHODS OF ACCESS

Responsiveness to queries can be provided by designing a system so that all management requests are anticipated and so that the specified reports can be delivered to the managers at specified internals. This is generally called "off-line batch mode." Generally, this approach is less expensive per report, because efficient production schedules can be developed at the computing facility. Off-line batch mode is very good for routine production of management reports, but provides a difficult interface for a manager needing to obtain nonroutine information. Frequently, he must resort to using an intermediary systems analyst to encode his query for the computer. This time delay added to the normal delay of batch-mode operations is frustrating to the manager. If the difficulty in producing special reports on short notice leads to a pattern of routinely generating reports that are needed only infrequently, the low cost per report does not necessarily lead to the lowest total cost.

The next level of sophistication in responsiveness to queries is to provide the manager with access to a terminal to relay the query to the computer for processing in a batch mode. All inputs are collected and are batch processed at convenient intervals. These systems again require some computer language capabilities of the manager as the query languages are oriented towards the traditional high-level computer languages, e.g., BASIC, etc. The systems analyst finds this mode of operation as a good interface between himself and the computer. Most managers are still frustrated.

The last mode that we will consider here is the on-line query mode in which the manager has access to a terminal.[10,11] His inputs are received at the computer at random times and are generally processed as they are received. Several attempts have been made to make the Management Information System (MIS) query languages as English-like as possible to allow conversation with a minimum of computer knowledge from the manager. Managers like this ability because they may browse pertinent data bases and gain rapid access to required information, even though there is generally an increased cost in fulfilling a single need.

On-line systems require additional computer memory and supervisory programs to keep track of all the users that may request information. It is a programming problem to determine how to use the computer memory--to hold work storage for all of the user programs (or as many as can fit), or to use it for the large system programs which are required to process user requests and to move the user areas in and out of computer core memory as they are required for processing. The trade-offs affect both hardware cost and user response time. For off-line systems, the chief concern is for efficient hardware usage rather than timeliness of responses to queries.

The time to insert new information into an existing file must be made to conform with laboratory needs. If batch-mode query is used, files may be made current by inserting update information into the file between the batch-processing runs. On-line systems, which can theoretically update the files as soon as a new item is received, generally also do some form of batch update. Random updates tend to use too much time (especially if the file has a complex structure), and they tend to interfere with on-line inquiries. Laboratories could not tolerate these random updates, because even though managers may become disenchanted with the old information, they become furious when a single report shows two different values for the same data element, or when a total does not reflect the sum of the parts.

On-line query systems have additional problems that were not to be found in batch-mode responses such as the length of response. The terminal user may not realize that he will have a long response to a query. This response can tie up the terminal and communications lines for an unreasonable length of time. Some systems anticipate this, and if an extensive reply is required, the system will inform the user so that he may indicate need for the information or refine his query to reduce the amount of output. Another problem with on-line systems is the limitation of resources. Not everyone can have his own terminal. Queueing up to use a terminal may become intolerable. This problem differs from most queue service problems, in that demand represented by the queue does not represent the true demand. Users not serviced soon go away, and gradually the queue disappears without service. This is the way that computer facilities which provide poor services go out of business.

In summary, the manager needs a combination of these techniques. Formats for reports and real-time needs can be met efficiently on the on-line, rapid-response systems. Production reports and lengthy responses to queries can be handled more effectively off-line.

2.0 DATA STRUCTURES

A number of storage structures are useful in the development of a MIS system. Storing a file of information represents a number of trade-off problems. If a structure is stored according to a single key, it will be recoverable by a single key. If the storage device's characteristics interfere with the way in which a data structure is accessed, that piece of hardware is not being used efficiently. An alternative method of file structure is to provide a number of keys (indices). However, this requires more storage of information which must be maintained. The most complex data structure is the fully inverted file. In this instance, cross-reference rosters are maintained which are arranged according to every indexable data item in the file.

Search for the information stored depends on the kind of index available. If only a single key is available, a search on any other field requires a complete file search. If the additional key is available as in inverted

systems, the same search can be conducted by locating only the areas of interest within the file. This does not always mean that the answer is obtained more rapidly in inverted file structures. Response time is dependent on the number of file accesses to be performed. Ultimately, for large data structures, it would be desirable for the system to have the ability to detect the rate at which a particular element is accessed and to dynamically alter the mode of update and search, i.e., use inverted index techniques for those data elements with high access rates within the last quantum of time, and sequential search techniques for those elements seldom accessed.

3.0 PRIVACY OF INFORMATION

Data privacy is a problem that has been addressed by numerous people, most urgently by those computer users worried about national security. Present DOD policies recognize that batch systems can handle data sets of varying security classification with acceptably low risk of compromise, but prohibit the general use of time-shared systems when users of differing access clearance are simultaneously on-line. A considerable investment is now being made by such agencies as DCA and DIA to develop time-shared systems that will win the confidence of security authorities.

4.0 PILOT MODEL RECOMMENDATIONS

The most cost-effective solution would appear to involve a combination of batch and on-line query modes. The batch-processing approach offers the most economical means of maintaining an up-to-date data base and fulfilling pre-established reporting requirements. One of the outputs of the batch system would be the periodic generation of a data base for entry into an on-line query system. The on-line query system would be used for browsing and for the generation of special reports on short notice. The frequency with which the on-line system would be loaded with the updated data base would be determined by balancing the cost of reloading against the penalties incurred in accessing outdated information. Although a reload of a data base into a fully-inverted on-line system requires substantial amount of computer time, the required time is less than that which would be required if on-line updating were attempted. Furthermore, if satisfactory data security control could not be established on the on-line system, the data bases created for that system would be limited to unclassified information.

It is our present intent to implement the batch portion initially on the NRL CDC 3800. This data base will be used to generate input tapes for a commercially-available time-shared data management system.

The code and data structures implemented on the CDC 3800 will be made as machine-independent as possible. Whereas the tapes for the time-shared system will be produced by the report generator, interfacing with a different time-shared system would involve only the specification of an additional report format.

APPENDIX F

SPECIFICATION FOR MULTIFUNCTION CRT TERMINALS

1.0 INTRODUCTION

This specification refines the specification dated 17 August 1970, issued in connection with RFP N00173-71-R-F010. In case of conflict between the two specifications, this latter specification shall be the controlling document.

Examination of the responses to the first step has revealed that there are many alternative equipments that can meet the functional requirements. In order to permit vendors maximum flexibility in offering products from their standard product lines, and in order to permit the Government to exercise a free choice over a variety of product lines, proposals of two types will be entertained: proposals for sets of free-standing equipments, and proposals for interconnected, integrated systems. Those bidders who propose sets of free-standing equipments will be permitted to select one of nine optional mixes of seven distinct types of terminals and stations whose detailed specifications are given in Section 3.

The number of terminals that will be procured may vary between two and sixteen. Whereas the most economic mix of terminals may vary with the total terminal number, bidders may propose and quote different types of terminals for the different numbers of total terminals. Accordingly a separte quotation form is supplied for each different number of total terminals.

2.0 SELECTION CRITERIA

It is considered in the best interests of the Government to reveal the methodology that will be used in selecting the successful bidder in order that bidders can predict which of their standard products will find most favor.

A separate comparison will be made of all quotations for each total number of terminals: thus all quotations for two terminals will be compared among each other; all proposals for three terminals will be compared among each other, etc.

These comparison will be conducted on the basis of effective cost to the Government, hereinafter termed "cost." The quotation offering the lowest cost will be favored. Cost will be determined by adjusting the price at which the vendor offers the equipment, hereinafter termed "price," by factors reflecting performance and additional life-cycle support factors which are discussed in detail in Sections 3 and 4. The term price, unless modified, refers to the total price of the set of equipments. It should be noted that these adjustments are <u>not</u> to be

chained; thus if the price is $10,000, and there are two adjustments of ten percent, the calculated cost will be $12,000, not $12,100.

This cost comparison will reveal for each number of total terminals the bidder offering the lowest cost system. There will be fifteen such "lowest cost" bids. The actual contract awarded will be to the bid with the lowest cost per terminal consistent with Laboratory requirements and funds available.

3.0 SETS OF FREE STANDING EQUIPMENTS

3.1 Form of Quotation

An individual quotation form for a specific total number of terminals need only indicate the mix of equipment types (using the terminology of Section 3.2), price per unit for each type included in the mix, and the total price. However, for each equipment type included in any quotation, there shall be appended to the set of quotation forms a complete technical and operational description of the equipment.

3.2 Definition of Equipment Types

3.2.1 Class A Terminal--A Class A terminal is a terminal that can independently perform all of the required functions.

3.2.2 Class B Terminal--A Class B terminal is a terminal that can perform all of the required functions except the printing of hard copy.

3.2.3 Class C Terminal--A Class C terminal is a terminal that can perform all of the required functions except the recording and reproduction of computer-compatible magnetic tape.

3.2.4 Class D Terminal--A Class D terminal is a terminal that can perform all of the required functions except the printing of hard copy and the recording and reproduction of computer-compatible magnetic tape.

3.2.5 Print Station--A Print Station is an equipment which produces hard copy from data recorded at terminals which do not have printing capability.

3.2.6 Tape Station--A Tape Station is an equipment which can record and reproduce computer-compatible magnetic tape and can convert this information into a form usable at terminals lacking an independent capability to record and reproduce computer-compatible magnetic tape.

3.2.7 Combined Station--A Combined Station combines the functions and capabilities of a Print Station and a Tape Station.

3.3 Options

It is left to the bidder to select for each quotation form one of the nine optional mixes of equipments defined in Section 3.3.1.

3.3.1 Definitions of options--

Option 1: A set of identical Class A terminals.

Option 2: A set of identical Class B terminals, plus one or more print stations.

Option 3: A set of identical Class C terminals, plus one or more tape stations.

Option 4: A set of identical Class D terminals, plus one or more combined stations.

Option 5: A mix of Class A and Class B terminals; the quantities are shown on the individual quotation forms.

Option 6: A mix of Class A and Class C terminals; the quantities are shown on the individual quotation forms.

Option 7: A mix of Class A and Class D terminals; the quantities are shown on the individual quotation forms.

Option 8: A mix of Class B and Class D terminals and one or more print stations; the terminal quantities are shown on the individual quotation forms.

Option 9: A mix of Class C and Class D terminals and one or more tape stations; the terminal quantities are shown on the individual quotation forms.

3.3.2 Cost Adjustments Associated with Options--In addition to the cost adjustments for the performance of the equipments, the following adjustments to price will be made in determining cost.

Options 2 through 9: If the recorded data must be physically carried between the less capable terminal and the more capable terminal or station, add 20% of the price in determining cost; if the communication can be accomplished over telephone circuits, add 12%.

Options 5, 7, and 9: Add (2000/r)% of the price of the Class A or Class C terminals in the set in determining the cost, where r is the printing rate, in characters per second, of the printer in the Class A or Class C terminals.

Options 6, 7, and 8: Add (3000/r)% of the price of the Class A or Class B terminals in determining cost, where r is the rate, in characters per second, of conversion to or from computer-compatible tape at the Class A or Class B terminals.

3.4 Specification of Equipments

3.4.1 Specification of Class A terminals--A Class A terminal shall consist of a keyboard, cathode-ray-tube display, printer, communications interface, two computer-compatible magnetic recorder/reproducers, and the necessary logic to perform the functions of data capture, editing, and time-sharing terminal operations discussed in Section 3.5.

3.4.1.1 Keyboard--The keyboard shall conform in general appearance to a typewriter keyboard with additional keys for communications control, display control, and editing. If an additional "adding machine" set of keys for numerics is offered, 1% of the price will be subtracted in determining cost.

The keyboard shall be capable of producing the 96-character subset of the 128-character ASCII set, including upper and lower-case alphabetics, as well as a sufficient number of the remaining 32 (control) characters to permit control of the terminals in all specified functions.

Numerics shall be in the same keyboard case as lower-case alphabetics; most of the special symbols (i.e., upper-case numerics) shall be in the same keyboard case as the capital letters. If the "normal" case, i.e., the case including numerics, contains capital letters and a shift operation is required to reach lower-case alphabetics, then the price will be increased by 5% in determining cost. However, if the desired configuration is offered, and an additional optional feature is offered to produce capital letters from the "normal" case when desired, i.e., to convert leading ASCII bits of 11 to 10 and to doubly mark the six keys whose meaning is changed thereby, then the price will be decreased by 4% in determining cost.

3.4.1.2 Cathode-Ray-Tube Display--The cathode-ray-tube display shall display at least 12 lines of 72 characters, and preferably 24 lines of 80 characters. If the display capacity is less than 1920 characters, the price will be increased by (1920 - c)/40%, where c is the display capacity, in determining cost.

The refresh rate of the display shall always be 50 Hz or greater, irrespective of the number of characters displayed. If the refresh rate can go below 50 Hz, the Government reserves the right to reject the proposal outright in lieu of assessing cost adjustments for psychophysical factors.

The screen size shall be appropriate to the number of characters, and the character size shall be appropriate to the working distance imposed by the display configuration. The intensity and contrast should be appropriate for use in a well-lit office environment. The characters should have sufficient detail to be unambiguous, and should, insofar as possible, resemble typewriter fonts, although it is permissible to distinguish the zero from the letter 'oh' by special symbols on the display (but not the printer). No particular method of character generation is specified, but the Government reserves the right to reject the proposal, in lieu of assessing cost adjustments for psychophysical factors, if the general display quality is judged unsatisfactory for the application.

The equipment proposed will be inspected by a team of technical and administrative personnel representing the intended users of the apparatus. This team will determine whether the display is satisfactory, and if they deem it satisfactory may select to adjust the price as much as 10% in either direction in determining cost, on the basis of such psychophysical factors as freedom from flicker, stability, contrast, intensity, character formation, etc.

Logical features of the display are discussed in Section 3.5.

3.4.1.3 Printer--The printer shall be capable of printing all displayed characters. The font shall resemble a typewriter font with zero,'oh', one, and 'el' distinguished by shape, but the shapes should not be bizarre and should be acceptable for publication. If the printer is incapable of producing multiple copies, the bid price will be increased by 5% in determining effective cost. If the clarity or contrast of the printed copy is insufficient for high-quality reproduction, the Government may, at its option, reject the proposal or increase the price by up to 10% in determining cost. If the printer requires the use of special paper, the life-cycle cost of procuring such paper will be added to the price in determining cost. If the printer can both friction feed and pin feed, the price will be reduced by 2% in determining cost.

The printer shall be capable of printing at least 10 characters per second. If the printing rate is less than 30 characters per second, the bid price will be increased by (30 - r)/6% where r is the printing rate in characters per second.

3.4.1.4 Communications Interface--The terminals will communicate with each other and with central computers through the Laboratory's dial telephone network. In determining effective price, the cost of procuring additional apparatus from the common carrier (e.g., data sets if no modem is supplied; access arrangements if a modem is supplied; perhaps nothing if a suitable acoustic coupler is supplied) over a six-year life-cycle will be added to the bid price.

Required baud rates are 110 and 300. If the interface can operate at higher speeds, e.g., 600 and/or 1200 baud, the price will be reduced by up to 5%, the exact factor being determined by the utility of the higher rates in the option proposed, in determining cost.

The terminals must be capable of operating in both full duplex and half duplex mode. If Options 5, 6, 7, 8, or 9 are proposed, the modem (if supplied) must operate in both originate and answer mode; if Options 1, 2, 3, or 4 are proposed, only the originate mode is required, but the price will be reduced by 3% in determining cost if the answer mode is offered.

3.4.1.5 Computer-Compatible Magnetic Recorder/Reproducers--Two units shall be supplied, each utilizing standard 1/2-in. computer-compatible hubs holding not less than 100 ft of tape. Nine-channel, 800 or 1600 bpi ASCII format is required. Both units must be capable of reproducing; at least one must be capable of recording, and if only one is capable of recording the price will be increased by 3% in determining cost.

3.4.2 Specification of Class B terminal--A Class B terminal must meet all the specifications of Section 3.4.1, except that a printer (Section 3.4.1.3) need not be supplied.

3.4.3 Specification of Class C terminal--A Class C terminal must meet all the specifications of Section 3.4.1, except that they may be substituted for the Computer-Compatible Magnetic Recorder/Reproducer (Section 3.4.1.5) a noncompatible type, e.g., cassettes. If the conversion from compatible to noncompatible media, and the reverse, is to be performed on Class A terminals (Option 6), then either the Class A terminals must have a recorder/reproducer capable of handling the noncompatible medium, or else the bidder must demonstrate a convenient conversion process employing communications interfaces and the telephone network.

3.4.4 Specification of Class D terminal--A Class D terminal must meet all the specifications of a Class C terminal (Section 3.4.3), except that a printer (Section 3.4.1.3) need not be supplied. In any option employing Class D terminals and more capable terminals for tape conversion or printing, either the more capable terminal must be capable of handling the same recording medium as used by the Class D terminal, or else the bidder must demonstrate a convenient conversion process employing communication interfaces and the telephone network.

3.4.5 Specification of Print Station--The Print Station must accept data from Class B or Class D terminals and print hard copy on multipart, pin-fed paper. The Print Station must reproduce the full set of displayable characters. The minimum printing rate shall be five characters per second per terminal. If the rate is less, a number of printing stations must be included in order to bring the overall printing capacity up to the specified value.

The cost of manning the printing station will be included in determining cost; therefore print stations that operate unattended and to which terminals can 'dial-in' will be advantageous.

3.4.6 Specification of Tape Station--A Tape Station must accept data from Class C and Class D stations and record it on computer-compatible magnetic tape to Class C and Class D terminals. The minimum conversion rate shall be 15 characters per second per terminal served If the rate is less, a number of tape stations must be included in order to bring the overall printing capacity up to specified value.

The communications between the tape station and the terminals it serves can be conducted either through communications interfaces and the telephone network, or else by providing the capability to record and reproduce noncompatible media at the tape station and physically transporting the media to and from the terminals.

Manning costs of the tape station will be included in determining cost.

3.4.7 Specification of Combined Station--A Combined Station must perform the functions of a Print Station (Section 3.4.5) and a Tape Station

(Section 3.4.6) at a rate equal to the sum of the specified rates, or else a sufficient number of Combined Stations must be included. Manning costs will be included in determining costs.

3.5 Specification of Required Functions

3.5.1 Data Capture--In the data-capture function, a format will be obtained from a reproducer or from the communications interface. This form will consist of a string of fields, the total length of which may exceed display capacity. Some of the fields will be fixed for operator prompting, and others will be variable for operator key-in. The fixed fields should be protected. Only the variable fields should be transmitted to a recorder or a communications interface. Communications to the printer may be only the variable fields or all fields. If both capabilities are furnished, the price will be reduced by 1% in determining cost.

It is required that the operator be able to skip a field with a single key operation while filling in information, and be able to "back up" through variable fields previously entered but still displayed.

Variable fields must be distinguished from fixed fields by some mechanism such as a cursor, but if a more sophisticated method of distinction is offered (e.g., variable intensity), the price will be reduced by 2% in determining cost.

3.5.2 Editing--In the editing function, a display may originate from the reproducer, the keyboard, or the communications interface. After the display is manipulated by the operator it must be transmissible to a recorder, the printer, or the communications interface. Material to be edited may be longer than display capacity, so provision must be made to link smoothly from one display frame to the next.

The minimum set of editing functions are insert and delete character(s) and insert and delete line(s). A highly desirable function is the ability to "push" and "pull", i.e., to move blocks of characters from one line to the next. If this function is not offered, the price will be increased by 8% in determining cost. A desirable function is the ability to change all occurrences of one specified string to another specified string for a multiframe record. If this capability is offered, the price will be decreased by 3% in determining cost.

3.5.3 Time-Sharing Terminal--In the time-sharing terminal function the terminal will be used to communicate with a number of commercial time-sharing services. The ability to communicate between the service and the recorder/reproducer and printer (either directly or through the display) is required. A scrolling option on the display is highly desired, and the price of proposals not offering this option will be increased by 8% in determining cost.

3.5.4 Software--It is anticipated that these functions may be

performed by a combination of hardware, firmware, and software. The bidder is required to furnish and demonstrate all required firmware and software.

3.5.5 Demonstration and Evaluation of Functions--The required functions will be demonstrated to the same team performing the psychophysical display evaluation. The team will determine whether the required functions are performed, and may adjust the price in either direction as much as 4% for each of the three functions on the basis of convenience and inconvenience in the performance of these functions, in their determination of cost.

4.0 INTEGRATED SYSTEMS

Proposals will be entertained for systems which are functionally equivalent to the suits of free-standing terminals but which consist of simpler terminals handwired to a central control unit.

The terminals of an integrated system will contain a keyboard and a display, but need not contain a general-purpose communications interface nor a recorder/reproducer. They may optionally contain a printer.

The central control unit will contain a shared random-access memory (e.g., disc) for simulating the local recorder/reproducers, a single computer-compatible magnetic recorder/reproducer for off-line communications with digital computers, sufficient communications interfaces to permit up to 1/3 of the total number of terminals to function as time-sharing terminals, and a high-speed print station.

The bidder must be prepared to demonstrate his system with operating software performing the three specified functions simultaneously.

4.1 Cost Adjustments

The following adjustments to price will apply in the determination of cost.

- The adjustment of Section 3.4.1.1, "Keyboard"
- The adjustments of Section 3.4.1.2, "Display"
- The adjustment of Section 3.4.1.3, "Printer," if local printers are offered
- The adjustment of Section 3.4.1.4, "Communications Interfaces," applied to the communications interfaces of the control unit
- The adjustments of Section 3.5.5, "Functions"
- The manning cost of the central unit
- The cost saving to the Government resulting from the reduced load on the dial telephone network

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- The cost increase to the Government resulting from the necessity of procuring and installing cables between the central unit and the terminals.

4.2 Alternative Proposal

Proposals will also be entertained for integrated systems that do not perform the time-sharing terminal function. In evaluating such proposals, the cost adjustments pertaining specifically to the time-sharing function and to the communications interfaces will not apply. However, it will be assumed that the Government will procure 20% fewer terminals and will be required to procure separately 40% additional free-standing terminals for the time-sharing application. Thus, for example, the effective cost to the Government of a suit of 16 free-standing terminals would be compared to the sum of

1. The effective costs to the Government of a 13-terminal integrated system not performing the time-sharing system

2. The cost of procuring six time-sharing terminals.

5.0 OTHER

5.1 Services and Supplies

The prices quoted should include delivery and initial setup of equipment and provision of two copies of technical and operational manuals for each unit. Prices of maintenance service and consumables should be quoted separately.

5.2 Leasing

If the vendor offers the equipment for lease, lease prices should also be quoted. In evaluating costs associated with leased equipment, a six-year life will be assumed and no provision made for interest.

5.3 Delivery

Delivery time is material to this procurement. It is required that either:

1. The equipment be delivered within 45 days of award, or

2. The equipment be delivered within 120 days of award and that the Government be permitted access of not less than 20 hours per week to substantially identical equipment commencing 45 days after award and terminating at acceptance of the equipment ordered. In the latter case, cost evaluations will include not only the price (if any) of this access, but also the transportation and indirect costs associated with this off-site access.

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13. ABSTRACT

The continuing need for efficiency in the management of Research, Development Test and Evaluation (~~RDT&E~~) programs conducted at naval laboratories has motivated an inquiry into the means by which program management information is collected, processed and disseminated. The use of this information in the fulfillment of reporting requirements imposed on naval laboratories has been considered, as has the internal management function.

Present procedures impose an unnecessary burden on Laboratory investigators who are required to supply numerous overlapping reports; these procedures do not serve laboratory managers well because the reports are individually incomplete and may be collectively inconsistent. The problem seems to arise from the tendency to pass down to the investigator the task of producing the required report in complete, publishable form. The solution to the problem involves separating the collection of information from the generation of reports, employing ADP techniques to bridge the gap.

The design goals of such a system, as well as a description of the necessary steps towards its implementation, are presented. Appendixes surveying technical alternatives for data capture, computer assisted publication, and conversational information systems, are included.

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Management Report Generation						